TOWARD UNIVERSAL BROADBAND IN RURAL ALASKA:

PART 1: AN ANALYSIS OF INTERNET USE IN SOUTHWEST ALASKA

PART 2: LITERATURE REVIEW

A Report of the Institute of Social and Economic Research
University of Alaska Anchorage

Principal Investigator: Heather E. Hudson

ISER Contributors: Virgene Hanna, Alexandra Hill, Khristy Parker, Suzanne Sharp, Kent Spiers, Kyle Wark

November 2012

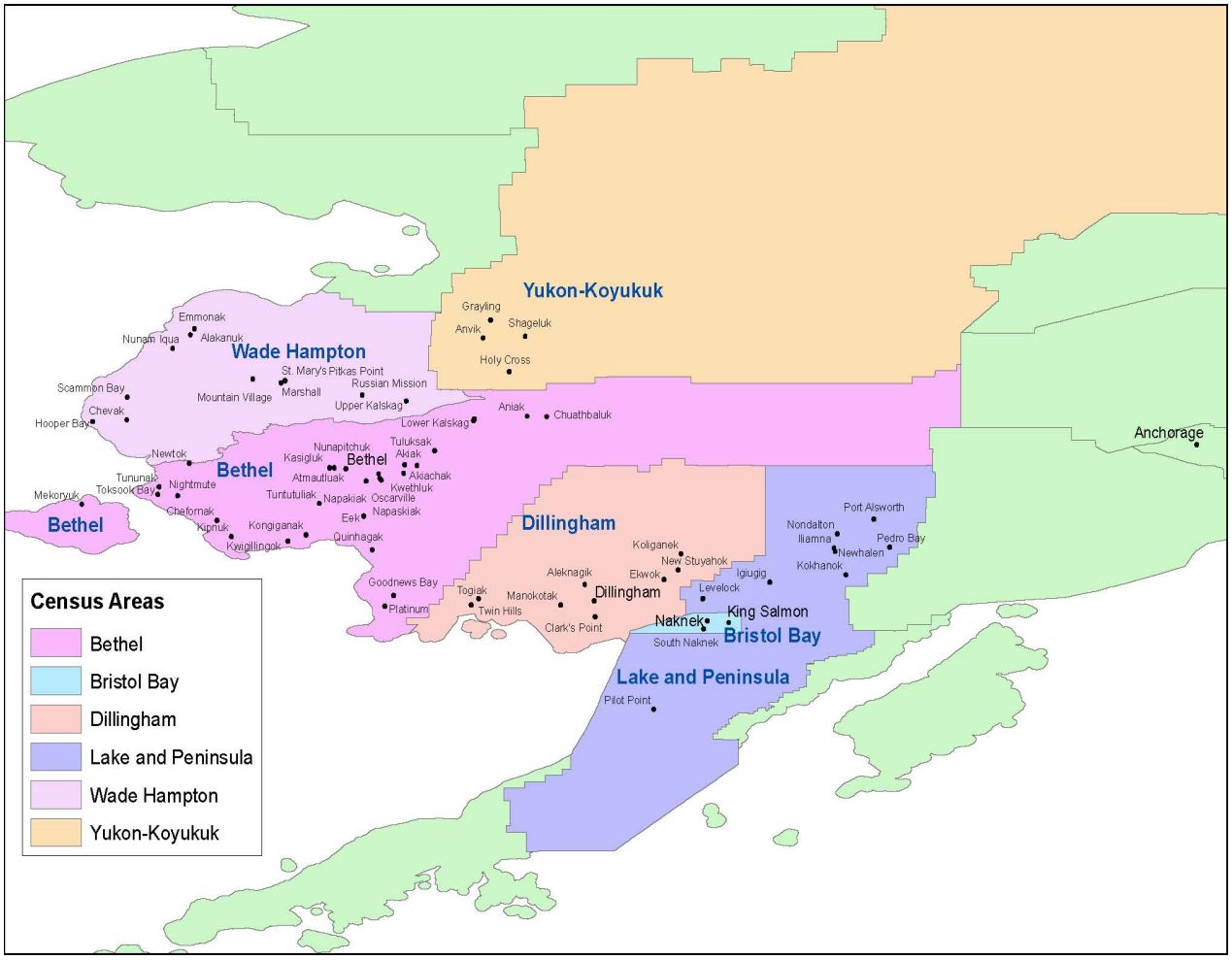
Support for this research came from Connect Alaska with funding from the National Telecommunications and Information Administration (NTIA) for the work of the State of Alaska Broadband Task Force, with additional support from GCI.

Contact: Dr. Heather E. Hudson: *hehudson@uaa.alaska.edu*

EXECUTIVE SUMMARY

Part 1: Survey of TERRA Region

TERRA Region showing Census Areas



EXECUTIVE SUMMARY:
TERRA REGION INTERNET USE STUDY AND LITERATURE REVIEW

The TERRA-Southwest project is extending broadband service to 65 communities in the Bristol Bay, Bethel and Yukon-Kuskokwim regions. A stimulus project funded by a combination of grants and loans from the Rural Utilities Service (RUS), TERRA-Southwest has installed a middle-mile network using optical fiber and terrestrial microwave. Last-mile service will be through fixed wireless or interconnection with local telephone networks.

The State of Alaska, through its designee Connect Alaska, also received federal stimulus funding from the National Telecommunications and Information Administration (NTIA) for tasks that include support for an Alaska Broadband Task Force "to both formalize a strategic broadband plan for the state of Alaska and coordinate broadband activities across relevant agencies and organizations."

Thus, a study of the impact of the TERRA project in southwest Alaska is both relevant and timely. This first phase provides baseline data on current access to and use of ICTs and Internet connectivity in rural Alaska, and some insights about perceived benefits and potential barriers to adoption of broadband. It is also intended to provide guidance to the State Broadband Task Force in determining how the extension of broadband throughout the state could contribute to education, social services, and economic activities that would enhance Alaska's future. Results of the research could also be used proactively to develop strategies to encourage broadband adoption, and to identify applications and support needed by users with limited ICT skills.

The following are some of the conclusions from the TERRA Internet/broadband study and the literature review that are relevant for the Task Force's strategic plan.

Households: Internet and Broadband

Internet use is already quite widespread in remote communities, and two-thirds of users are online almost every day. Thus, many people in the region are already "Internet-savvy," but most are dissatisfied with slow speeds and uneven quality of service, and would like faster and more reliable connections.

Community access is important for Internet users, including those with home subscriptions. Outside the home, they access the Internet at work and at school, and also at libraries and tribal offices. About 60 percent think members of their household will access broadband elsewhere in the community, even if they subscribe at home.

There is definitely *enthusiasm about broadband*—only 8 percent think their households definitely won't subscribe (this is considerably fewer than among rural residents across the country). About 45 percent think their households would definitely sign up for broadband. The remainder, who aren't sure, are primarily concerned about cost—monthly subscription and overages or other charges.

Concerning likely *uses of broadband*, personal communications and entertainment ranked highest (social networking, downloading music and video, playing online games). However, 48 percent said they expected to use broadband for education, 45 percent said they would use Skype or similar services for video conferencing, and 39 percent said they would use broadband for work or telecommuting. The interest in education and telecommuting indicate that broadband could help residents upgrade their education and work from their homes or communities.

In many locations, more than one-third of households have their own VSATs (except in Bethel, where cable and DSL access are available). Those households with satellite service may indicate how *early adopters* of broadband may use the service, as they have chosen to upgrade to higher speed Internet service than is currently available from local carriers. Some 88 percent of satellite users accessed government services online, 87 percent accessed financial services, while 68 percent used the Internet for education, and 62 percent for work or telecommuting. These early adopters of the fastest connections available provide some indication that future broadband users will take advantage of broadband for work, education, and public and private sector services not available in their communities.

Educational use of broadband from home is likely to increase, as more schools provide laptops to students. To derive maximum benefit from the laptops (or tablets) students need to be able to access the Internet from home, where laptops can also be shared with other family members.

Other services that residents thought they would use include online banking, reservation services, and online shopping.

Cellphone penetration is high, with 87 percent of households having at least one cellphone and 60 percent of households having a smartphone. Primary use is for voice and text, but may also use their mobile phones to access the Internet for social networking, browsing the web, and sending and receiving photos, etc. However, bandwidth and speed are limited for these applications. Some residents take their smartphones to school where they can use the WiFi connection. More than 50 percent also have an iPad or other tablet, or e-reader. There will thus clearly be demand for *mobile broadband*.

The need for digital literacy training among people with limited experience in using the Internet, the generally widespread use of computers and other devices, and upgrades in connectivity all indicate a need *for local employees with IT skills*. These IT workers could provide training as well as technical support in each community.

Organizations and Businesses: Internet and Broadband

Respondents from *Native organizations* commented that broadband could save them time in accessing online information and software compared with time required using current Internet services, and would be beneficial in applying for grants and filing reports with funders, and helping tribal members applying for jobs. Some also noted opportunities to offer training in villages, and to help local entrepreneurs develop websites to sell crafts and other products.

The *tourism industry* also requires reliable communications to support its operations and build businesses. Fishing lodges and other wilderness tourism businesses rely on telephone and email to respond to potential customers, and websites and travel agencies to attract business. Similarly, businesses in hub communities use online services to attract customers and manage their operations.

The *seafood processing* industry would definitely benefit from faster connectivity to run its back-office operations, such as uploading catch information, payroll and other accounting data, and using other software for business. They also have thousands of seasonal workers who want to use the Internet to keep in touch with family and friends and to access entertainment. Broadband wireless connectivity to boats and processing vessels would be used both to keep crews up to date on operations as well as to provide personal broadband access for crews and seasonal employees. These applications for logistics and back-office communications as well as for personal use by employees are also likely to apply to other key industries in rural Alaska, such as mining and oil and gas.

The study did not include data collection on *educational institutions* (schools, community colleges, and others) or *health services*, as substantial information is available from other sources. However, these sectors will continue to be major users of connectivity. Schools offer access to online courses that are not available locally and provide computers that students use to access the Internet for assignments and research projects. Continuing education for teachers is also available online. Increasingly, schools are providing laptops or tablets for students to use in class and take home, where it is expected that they and family members can access the Internet.

Alaska is a pioneer in telemedicine, with some 248 sites connected to the AFHCAN network that links village clinics to regional hospitals, and regional hospitals to ANMC and other sources of specialists and consultants such as radiologists. Both schools and rural health-care facilities receive subsidies for connectivity from federal universal service funds.

Highlights from the Literature Review

Broadband infrastructure appears to reduce costs and/or increase market access, and thus lead to job creation and growth in total employment. A World Bank study concludes that every 10 percent increase in broadband penetration accelerates economic growth by 1.38 percent in low- and middle-income countries (which are perhaps more comparable to Alaska's rural economy than national economies of OECD countries).

Several studies have examined impact on sectors that are found in Alaska. For example, broadband can contribute to employment growth both as a result of infrastructure construction and spillover effects on the rest of the economy, particularly in sectors with high transaction costs such as financial services, education, and health care. Another study found that broadband deployment positively impacts mining, construction, information, and administration. Some of these findings were echoed in another study that found broadband expansion and employment growth varies across industries, and that the positive relationship is especially large for utilities; information; finance and insurance; professional, scientific, and technical services; management of companies and enterprises; and administrative and business support services. It also noted that

the relationship between broadband and employment growth is stronger in places with lower population density.

Benefits can be classified in terms of:

- *Efficiency*, such as saving them time in applying for grants and filing online reports and business data; keeping track of inventory; and managing operations;
- *Effectiveness*, referring to the quality of services provided such as in health and education;
- *Equity*, reducing the distance barriers between rural and urban communities by providing access to information, entertainment, education, and other services not otherwise available in remote communities;
- *Reach*, enabling Alaskans to extend their range electronically to market Alaska Native crafts, tourism, and other local assets.

Concerning *e-governance*, a study found that increasing the broadband network significantly reduces inefficiency in state economies. Another study stated that use of social media as part of e-governance strategies increases social and digital inclusion and thereby political inclusion.

Studies of *natural resource industries* such as mining, fisheries, forestry, and petroleum report that broadband can be used for logistics and back-office management, training of workers, and, in some cases, supporting development of new markets or trading partners.

Concerning *public safety and disaster communications*, experiences with man-made and natural disasters in the U.S. ranging from terrorist attacks to floods, oil spills, and forest fires have demonstrated the need for telecommunications networks that are robust and interconnected. In Alaska, beneficiaries could include village public safety officers, forest fire fighters, oil spill response teams, and others.

However, several studies point out that broadband and other investments in information and communications technologies (ICTs) may be *necessary but not sufficient* for economic development. As one researcher points out, the impact of broadband is neither automatic nor homogeneous across the economic system. Therefore, public policies may be needed in other areas such as telecommunications regulation, education, economic development and planning, and science and technology.

Estimating Benefits for Alaska

Estimating the value of benefits of broadband investment in Alaska was beyond the scope of the current ISER research. However, several approaches could be considered to get an estimate of the number of workers and organizations/businesses that would benefit, and some idea of new job creation.

For example, beneficiaries could include:

- Education: total number of rural students and rural teachers
- Health care: total number of rural health aides
- Public safety: total number of Village Public Safety Officers (VPSOs)

- Alaska Native organizations: Alaska Native corporations, village corporations, tribal councils, and Alaska Native nonprofits
- Resource industries: seafood processing companies, mining companies, oil and gas companies, and others
- Tourism: ecotourism, tour operators, lodges, and others
- Other rural businesses: estimates of number of businesses, from state data

For workers in these sectors, their jobs may be enhanced and skills improved by access to broadband. For many of these entities, economic benefits may be cost savings in terms of increased efficiency or travel substitution. For example, research by ANTHC has documented travel savings from telemedicine of over $2.85 million dollars for Medicaid from 2003 to 2009, so that for every $1 spent by Medicaid on reimbursement, $10.54 was saved on travel costs. For others, there may be increased revenue and possibly new jobs—for example, from more grant funding received by Alaska Native organizations and more business for tour operators and lodges.

It is difficult to estimate the number of new jobs resulting from broadband availability, but it may be possible to indicate some types of new jobs such as:

- IT workers/trainers in each community;
- Self-employed entrepreneurs who could sell crafts and other products online;
- New types of jobs such as environmental monitoring;
- Possibly new jobs such as telework to do back-office data entry or customer support.

Benefits in terms of upgrading skills and accessing services such as banking and online shopping that would improve quality of life and save money or increase income could potentially accrue to all adult rural residents.

Finally, it is worth noting that while the rural Alaska population is relatively small, it is also young. For example, the median age in the Wade Hampton Census Area is 22.5; in the Northwest Arctic Borough, 25.7; in the Bethel Census Area, 26.4; and in the Nome Census Area, 27.5. Rural Alaska youth will grow up using computers and mobile phones, but will also need job opportunities if they are to remain in their communities as adults.

AN ANALYSIS OF INTERNET USE IN SOUTHWEST ALASKA

1. Introduction

Alaska is the largest state in the U.S. (571,951 square miles or more than twice the size of Texas), but with the nation's lowest population density, of only 1.2 persons per square mile. Its total population is about 710,000, of which 14.8 percent are Alaska Natives.[1] Approximately two-thirds of the indigenous population lives in more than 200 villages, most of which are remote settlements with fewer than 200 people. The concept of "rural" has a different connotation in Alaska than in many other regions; some 75 percent of Alaskan communities have no road access.

Since the late 1970's, all communities with at least 25 permanent residents have had telephone service (primarily by satellite), but broadband connectivity remains limited to cities and to larger towns. Extension of terrestrial broadband is challenging because of difficult terrain including mountain ranges, remote islands, rivers and lakes, and permafrost, and the need to rely on boats, barges and especially aircraft for equipment transport and access.

The TERRA-Southwest project is extending broadband service to 65 communities in the Bristol Bay, Bethel and Yukon-Kuskokwim regions.[2] A stimulus project funded by a combination of grants and loans from the Rural Utilities Service (RUS), TERRA-Southwest has installed a middle-mile network using optical fiber and terrestrial microwave. Last-mile service will be through fixed wireless or interconnection with local telephone networks

The State of Alaska, through its designee Connect Alaska, also received federal stimulus funding from the National Telecommunications and Information Administration (NTIA) for tasks that include support for an Alaska Broadband Task Force "to both formalize a strategic broadband plan for the state of Alaska and coordinate broadband activities across relevant agencies and organizations."[3]

Thus, a study of the impact of the TERRA project in southwest Alaska is both relevant and timely. This first phase provides baseline data on current access to and use of ICTs and Internet connectivity in rural Alaska, and some insights about perceived benefits and potential barriers to adoption of broadband. It is also intended to provide guidance to the State Broadband Task Force in determining how the extension of broadband throughout the State could contribute to education, social services, and economic activities that would enhance Alaska's future. Results of the research could also be used proactively to develop strategies to encourage broadband adoption, and to identify applications and support needed by users with limited ICT skills.

2. Previous Studies

Several recent studies have examined broadband adoption and reasons for nonadoption among U.S. residents, with some data disaggregated by various demographic and ethnic criteria (age, education level, urban/rural, gender, ethnicity, etc.) The Federal Communications Commission (FCC) carried out a study in 2009 to examine broadband adoption and use; the top reason given by non-users for not using the Internet was affordability. [4] The 2010 report *Exploring the Digital*

Nation by the National Telecommunications and Information Administration (NTIA), states that "persons with low incomes, seniors, minorities, the less-educated, non-family households, and the nonemployed tend to lag behind other groups in home broadband use." It provides detailed analysis of broadband adoption gaps: for 26 percent of non-broadband users, the main reason for non-adoption was that home broadband Internet was too expensive. Among those who did not use the Internet at all, price and perceived relevance were cited as key considerations. [5] [6]

While helpful in increasing our understanding of barriers to adoption among various groups including minorities, these studies do not have samples of Alaska Natives large enough to provide any valid findings. For example, the NTIA study states that 42.6 percent of American Indians/Alaska Natives used broadband at home, but there is no separate breakdown for Alaska Natives.[7] The FCC report also states that the sample of Alaska Natives is too small to report results.[8] Within that category, it is also important to disaggregate Alaska Natives by urban and rural, as broadband availability is very limited in rural Alaskan communities, which are primarily inhabited by Alaska Natives. Thus, while NTIA data indicate that 70 to 76 percent of Alaskans use broadband, this estimate is likely to be highly skewed by the urban population.[9]

The FCC's recently released *Eighth Broadband Progress Report* estimates that 53 percent of Alaska Natives living in "village areas" do not have access to broadband.[10] Connect Alaska has conducted some broadband usage surveys, but it does not appear that their sample is adequate to identify usage and perceived needs of people in remote communities, particularly Alaska Natives.[11] However, the metrics used in these studies may not be relevant for small Native communities where access may largely be at schools, libraries, community centers, or tribal/local government offices.

3. Current Connectivity

Connection to the Internet in the region has been by satellite backhaul, with a variety of technologies linking users to local switches and satellite terminals. Some local companies offer DSL. WiFi connects to satellite facilities in many villages. However, the throughput ranges only from dial-up (19.2 kbps) to 128 kbps or in some cases, 256 kbps. The limited transmission rates plus satellite latency make Internet service very slow for users. Bethel is the only community with cable modem service, and available packages with 2 mbps or more. Some households and businesses have installed VSATs with download speeds ranging from 256 kbps to 1.5 mbps or greater.

Most of the communities now have cellular service, although coverage may be limited for people out on the land or on the water. Much of the region now has EDGE (2.5G) service, while some areas have only 2G GSM service.

4. Analytical Framework and Research Methodology

We propose an analytical framework for broadband adoption that takes into consideration the geographical and cultural environments in indigenous communities of rural Alaska. Elements of the framework include:

- **Personal Use:**
  - Through smartphones or tablets, etc. that could access broadband using local WiFi networks or 2.5G mobile networks that may be available in some communities.
- **Household Use:**
  - Members of a single household using facilities at home.
- **Community Use:**
  - Public use of broadband at community centers, libraries, Tribal offices, or other publicly accessible locations.
- **Institutional Use:**
  - Use of broadband by employees or clients of organizations such as small businesses; major regional businesses such as fisheries, aviation, and tourism; Native corporations and nonprofit organizations; tribal councils, etc.

To gather information on these various categories of users and usage, two major forms of data collection were adopted:

- Telephone interviews with a random sample of residential telephone subscribers in TERRA communities;
- Telephone interviews with key informants such as Tribal leaders, managers of local businesses, managers of Native corporations and nonprofit organizations.

The residential component of this report is based on a telephone survey of a sample of the approximately 9,700 households in the communities to be served by of the TERRA Southwest project. A random sample was drawn from both landline and mobile phone numbers assigned to residents of the region; cellphone numbers were included because many residents now rely on cell phones as their primary means of voice communications. We contracted with Marketing Systems Group of Horsham, PA to provide two stratified random digit dial samples, one of land lines and one of cellular lines in southwest Alaska.

Delays in obtaining funding resulted in interviewing during June and early July when some residents were involved with commercial or subsistence fishing; as a result, the sample included more residents with post-secondary education, and slightly more respondents from larger communities than would be expected from a random sample. The responses were therefore weighted to represent the demographics of the region.

We stratified the sample to ensure that there would be adequate representation of households in small villages as well as larger towns, and of the different geographic/cultural regions in the area. There were eight land line strata and two cell strata. Each land line stratum was defined by the prefixes assigned to communities in the relevant geographic area. Numbers within each stratum were selected in proportion to their share of listed telephone households from active

blocks (area code /exchange/two-digit block number with at least one residential directory listing). The sample provider pre-screened the land lines for non-working and business numbers. The two cell strata were defined by the 1000-series blocks associated with each of four switching centers (the Bethel-area stratum contained only the numbers associated with the switching center in Bethel, and the Bristol Bay stratum contained numbers associated with the two switching centers near Dillingham and one in the Bristol Bay Borough). Numbers were selected in proportion to the number of active cell numbers in each of the relevant 1000-series blocks.

To weight the sample across the strata, we created a preliminary weight for completed interviews in each land line stratum to total households in that stratum, and each cell stratum to the estimated number of household with cell phones in the cell switch area. However, because we started with two separate stratified samples (land line and cell), the preliminary weights had to be adjusted downward so that the two samples together were weighted to just the total households in the area surveyed. We calculated the secondary weights (one for the entire land line sample and one for the entire cell sample) that would be proportional to the relative numbers of completed interviews in each sample and together would weight the total sample correctly to total households reported in the 2010 census.

We conducted the telephone survey over six weeks from June 5 to July 17, 2012. A total of 340 interviews were completed, with screening to assure that there were no duplicate respondents from the same household. Interviewers were trained in human subjects protection and in the protocols of this survey over two days in late May, 2012. Calls were monitored by a supervisor to ensure calls were made at varying times and days. Interviewers made up to 12 calls before a number was excluded. Once an appropriate respondent was reached, the interviewer obtained informed consent, conducted the survey and entered the data into an electronic database.

The instrument included several questions used in the U.S. Census Bureau's Current Population Survey (2011) in order to compare results from this study from those reported in the NTIA's *Digital Nation* reports. Some questions were also drawn from the Organization for Economic Co-operation and Development's (OECD) latest ICT user survey.[12]

Indicators used in developing the interview protocol include:

- Availability of mobile phones
- Uses of mobile phones
- Availability of Internet at home
- Means of accessing the Internet
- Current monthly charge for Internet at home
- Use of Internet elsewhere in community
- Internet applications
- Reasons for not subscribing to Internet
- Intent to subscribe to broadband
- Intended uses of broadband
- Reasons may/will not subscribe to broadband
- Sources of information for community and region
- Sources of information for state and outside Alaska

5. Demographics

Household income varies substantially throughout the region, with the highest household income in the Bristol Bay Borough, and lowest in the Wade Hampton and Yukon-Kuskokwim Census Areas. Commercial fishing is the major industry in the Bristol Bay Borough, while subsistence fishing and hunting are mainstays of the local economy in most villages. With its low cash income and relatively young population, the Wade Hampton Census Area has the lowest per capita income ($11,269) in the state.[13]

As reflected in the income disparities, employment opportunities vary greatly within the region. The lowest unemployment rate (4.1 percent) is in the Bristol Bay Borough where the primary economic activity is commercial fishing, while 21.5 percent were unemployed in the villages in the Wade Hampton Census Area and 14.9 percent in villages in the Yukon-Koyukuk Census area.

Table 1: Income and Household Size[14]

District	Median Household Income	Average Household Size
Bristol Bay Borough	$84,000	2.56
Dillingham Census Area	$60,800	3.42
Bethel Census Area	$52,214	2.66
Lake and Peninsula Borough	$40,909	3.30
Wade Hampton Census Area	$37,955	4.28
Yukon-Koyukuk Census Area	$33,712	2.61
Alaska	$66,521	2.68

Table 2: Unemployment Rate: May 2012[15]

Bristol Bay Borough	4.1%
Lake and Peninsula Borough	8.0
Dillingham Census Area	10.2
Bethel Census Area	15.4
Yukon-Kuskokwim Census Area	14.9
Wade Hampton Census Area	21.5
Alaska average	7.3%

In our household survey, 44 percent of the respondents were working full time (as employees or self-employed), 23 percent were working part time or were seasonally employed, and 23 percent did not currently have paid employment. As reflected in Table 2 above, the number of respondents who were not employed was highest in the villages.

Respondents were not asked to state how much they earn, but only about education and employment, which we found to be highly correlated – i.e. those with college education tended to

be employed full time; those with only high school education had higher rates of part time or seasonal employment. Unemployment was highest among those with high school education or less. In general, respondents with more education were more likely to be working, and to be working more hours, than those with less education.

Table 3: Racial Identification and Additional Languages

Alaska Native	73%
Caucasian/white	23
Other	4
Speak Native language at home	56%
Speak another language at home	3

Approximately 73 percent of those interviewed identified themselves as Alaska Natives, while 23 percent stated they were white or Caucasian, and 4 percent were other racial categories.

About 56 percent of respondents spoke a Native language at home, with the highest percentage (64 to 77 percent) in the villages. An additional 3 percent spoke another language at home in addition to English.

Table 4: Education Levels:

Less than high school:	7 %
Completed high school	46 %
Some college (includes vocational)	26 %
4-year college degree or higher	21%

The percentage of respondents in the survey with more than high school education was somewhat higher than the overall regional average. The highest percentage of college-educated were in the towns, while high school completion was the most common level in villages.

As noted above, part of the explanation for higher education levels and more respondents with jobs is likely the timing of the survey – during fishing season, where people involved in both commercial and subsistence fishing were more likely to be away from their homes or out of cell phone range.

6. Mobile Phones: Access and Use

Respondents were asked about cellphone ownership and use because mobile devices can be an important means of accessing and sharing information, and smartphones may become an increasingly important means of accessing the Internet. Cellphone penetration was very high throughout the region, with an average of 86.7 percent of households having at least one cellphone. Access was high in all subregions, with the highest being in interior villages (90.5 percent). Of these, a high percentage were smartphones, e.g. iPhone, Android phone, or Blackberry.

Just 10 percent of mobile phone users said they used the phone only for voice calls. The most popular application after voice was texting, with 83 percent saying they use their phones to receive or send text messages (which would not require additional bandwidth). However, half the respondents with cellphones said they use their phones to browse the web, and more than 40 percent listed other applications, most of which would require smartphones. There was little variation in most popular uses across the region, although respondents in Bethel and Dillingham were more likely to use their phones for email than other respondents (48 to 54 percent). Some 30 to 35 percent of respondents in Bethel and Dillingham used them for mapping or GPS navigation.

Table 5: Respondents' Uses of Mobile Phones in Addition to Voice Calls:

Sending or receiving text messages	83%
Taking photos or videos	62
Browse the web	51
Listen to music or other audio	49
Play games	48
Access social network sites	44
Download apps	41
Share photos or videos	41
Send/receive email	37
Watch videos	22
Use maps or GPS	22

Some respondents said they were able to use their smartphones for social networking at school, apparently by using the school's WiFi network rather than the mobile network. Others said that connectivity over smartphones was too slow for services such as email, Skype, GPS or maps, and streaming audio or video, news feeds, etc. One noted that she would use many of these services on her phone in Anchorage, but that it was "dumb" to try many of them in her community: "Using the Internet on my mobile phone is like pulling teeth…. It just doesn't make sense to use it unless you want to wait two days for something to load." Another said that he cannot text in his home community, but does text while traveling.

The high penetration of smartphones and major uses for services other than voice and text indicate that mobile devices are likely to be an important means of accessing broadband services in the region. A respondent commented that cellular service seemed to be forgotten or ignored in the broadband rollout. Another pointed out that there are dead spots within the community where basic cell service won't work and calls drop, noting that "people's lives depend on being able to 'reach out and touch' somebody."

7. Access to the Internet

Internet access is already quite widespread, with a total of 59.8 percent of respondents having Internet service at home. However, penetration was much higher in the towns (84.9 percent in Bethel, 78.6 percent in Dillingham, and 77.6 percent in Bristol Bay Borough) than in the villages, where less than 50 percent of households have Internet service.

Table 6: Have Internet Service at Home

Bethel	84.9%
Dillingham	78.6
Bristol Bay Borough	77.6
Villages: Dillingham, Lake and Pen Borough	47.6
Villages: Bethel/Wade Hampton/YK	43.4

Connecting to the Internet:

Generally, those who had Internet at home used whatever technology was available locally to connect: DSL, cable modem in Bethel, and terrestrial wireless. However, satellite service (via VSAT) was the most common means of accessing the Internet in Dillingham (42 percent) and Bristol Bay (39 percent), and for more than 30 percent of village subscribers. The only region with very low satellite use was Bethel (2 percent of subscribers), which has both cable and DSL service.

Some 8.5 percent of those with Internet at home subscribe only to dial-up service, with the highest percentage being in the Bristol Bay Borough and Bethel/Wade Hampton/YK Census Region villages.

Table 7: Technologies Used for Internet Access

	Dial-up	DSL	Cable modem service	Satellite (VSAT)	Fixed Wireless	Mobile broadband plan (smartphone or USB stick)
Bethel	2%	25%	65%	2%	27%	9%
Bristol Bay Borough	16%	34%	6%	33%	0%	6%
Dillingham	10%	17%	36%	42%	16%	16%
Villages Bethel Wade Hampton YK	14%	30%	7%	30%	32%	12%
Villages Dillingham L&P	2%	23%	5%	39%	28%	2%

Ownership of Devices:

Of those households with Internet connections, more than 80 percent have a laptop computer, while more than 60 percent have a desktop computer, and virtually all of them are used for Internet access. Some 60 percent also have smartphones, and more than 90 percent of those also are connected to the Internet. Many households also own other electronic devices such as game systems, tablets and iPods (MP3 players), and most of these are used to connect to the Internet as well.

Table 8: Ownership of Devices among Internet Subscribers

Device	Ownership	Percent who use device connect to Internet
Laptop computer	82.0 %	97.0%
Desktop computer/PC	62.6	98.4
Smartphone	59.4	95.5
Game system (Wii, Xbox, PlayStation)	58	58.0
Tablet, iPad, e-book reader	54.5	82.7
Netbook	13.3	98.4

Internet Access at Other Places:

At least two-thirds of respondents said that someone in their household accessed the Internet from another location in the community. The most popular locations were the workplace and schools. The workplace was the most common among those in Dillingham, Bethel and the Bristol Bay Borough, while schools were most popular in the villages.

More than 40 percent said they accessed the Internet at someone else's house. Other locations were libraries (more than 40 percent of those in towns), while the Tribal office was a popular access point in villages. About a quarter of household members in Bristol Bay and Dillingham used Internet cafes or WiFi hotspots.

Of those without home Internet access, more than 60 percent had someone in the household who accessed the Internet elsewhere in the community: most commonly at school or at work. However, those with Internet at home also tended to go online elsewhere in the community at work (77 percent) or at school (59 percent). Residents also tended to use libraries where they were available, and Tribal offices in villages. Some noted that the library is closed during summer months; schools also generally are not open.

Of those who reported Internet access at school, 80 percent said school students in their household used the Internet at school, while 49 percent said other household members accessed the Internet at school. In the villages, 54 percent of households had members other than students using the school's Internet facilities. Clearly, school access is important for many residents. Yet

as more schools participate in "one laptop per student" programs, those without Internet access at home will remain at a disadvantage.

Table 9: Internet Use Elsewhere in Community

Someone in the HH accesses the Internet at:	Do you have Internet service in your home?		Total
	Yes	No	
School	59%	63%	60%
Work	77%	51%	67%
Library: not at school	37%	25%	32%
Community center	11%	19%	14%
Tribal office	27%	38%	31%
Internet cafe, coffee shop, or Wi-Fi hot spot	15%	11%	14%

8. Internet Usage

Frequency of Use:

More than two-thirds of Internet users in the TERRA region are on online every day or almost every day.

Table 10: How often do people in your Household use the Internet?

Every day or almost every day	69%
At least once a week	14%
At least once a month	5%
Less than once a month	8%
Don't know	3%

As might be expected, frequency of Internet usage is correlated with education: almost all (99 percent) of those with a four-year degree or higher and 79 percent of those with some college or vocational training used the Internet every day or almost every day. Frequency of usage was considerably lower among those with just a high school education or who had not completed high school.

Table 11: Frequency of Internet Use by Education Levels

People in HH use Internet	Less than High School	High School / GED	Vocational or some college	4-year College Degree or higher
Every day or almost every day	35%	61%	79%	99%
At least once a week, but not every day	31%	18%	14%	1%
At least once a month, but not every week	18%	8%	2%	0%
Less than once a month	16%	13%	5%	0%
	100%	100%	100%	100%

Internet Applications:

The most popular use of the Internet is for email, followed closely by general searches for information and social networking. Online shopping is very popular (76 percent of households), likely because choice of goods in small communities is very limited, and postal rates are relatively inexpensive. About 62 percent said their households used the Internet for online banking and for accessing government services. These applications are significant because villages have no banking services, and many government forms and other information are available online. Most communities would not have any local access to these government services. Another important application is for education and training, with 56 percent of households using the Internet for education-related tasks such as school projects or online classes. Library resources are extremely limited in villages.

Table 12: Respondents Reporting Someone in their Household uses Internet for:

	All	Satellite Users
Email	85%	95%
Finding information such as news, weather, sports	82	91
Social networking such as Facebook, Twitter	81	94
Online shopping	76	90
Download and/or stream music or videos	65	85
Online banking or other financial services	62	74
Accessing government services, forms, information	62	88
Uploading content such as photos or videos	61	77
Education or training, school research, online class	56	68
Maps, GPS	44	65

Several respondents commented that they would like to do many of these things: such as use Skype, play online games, or download videos, but that the current connection was too slow or unreliable. One said that getting online real-time flight information is important, particularly since when they get flights, there is only one per day, and they need to know whether it is on time.

Some noted that the connection would crash repeatedly if they tried to download videos. Others were concerned about price, discussed in more detail below.

Satellite users, who have opted to install their own broadband connections, use more of these applications, and some much more intensively. For example, 90 percent go online for online shopping, 88 percent to access government services or information, 68 percent for education or training, and 62 percent to work from home. Their use may indicate how early adopters will use and benefit from terrestrial broadband.

Internet usage is much greater among those with more education. Those with less than high school education appear at a major disadvantage in terms of benefiting from Internet use for other than entertainment. Only 19 percent said they used the Internet for online shopping (compared to 70 percent to 96 percent of those with more education), so that those with least income are likely paying most by relying on local stores or occasional visits to cities by family members. Only 1 percent said they accessed government information or services online, compared with more than 80 percent of those with some college education or more. This disparity points to the need both for community access and for digital literacy training and assistance from "infomediaries" so that people with less education can take advantage of broadband services.

A more positive indicator is that 37 percent of households where the respondent had less than high school education include a member who uses the Internet for education – most likely school students. As computers and the Internet are increasingly integrated into school curricula even in small village schools, the next generation is likely to be both computer literate and able to take advantage of a wide range of applications.

Table 13: Internet Applications by Education Level

	Less than High School	High School /GED	Vocational or some college	4-year College Degree or higher	Total
-Email	58%	78%	92%	99%	84%
-Social networking (e.g. Facebook, Twitter, etc.)	74%	74%	90%	89%	81%
-Work from home or telecommuting	14%	21%	47%	70%	38%
-Online shopping	19%	70%	88%	96%	76%
-Find information (such as news, weather, and sports information)	30%	78%	91%	99%	82%
-Download and/or stream music or videos	58%	64%	60%	76%	65%
-Internet phone calls or video conferencing, like Skype	11%	19%	32%	50%	28%
-Accessing government services, forms, and information	1%	47%	82%	93%	62%
-Education or training (such as research for school or taking a class online)	37%	43%	64%	82%	56%
-Look for jobs	15%	41%	52%	51%	44%
-Online banking or other financial services	25%	50%	69%	93%	62%
-Healthcare information or appointments	15%	18%	35%	62%	32%
-Maps/GPS	14%	29%	54%	77%	44%
-Upload content like photos or videos	25%	58%	56%	84%	61%
-Sell goods or services online (such as using eBay or through a website)	11%	16%	26%	37%	22%

9. Considerations about Internet Service

Those surveyed said the most important considerations about Internet service are: reliability of connection (90.8 percent), connection speed (89.5 percent), and price (81.7 percent). These three factors were consistently ranked highest in all subregions. Some users also specifically expressed concern about data usage limits, which could be considered an element of price. Two other factors – a specific service provider and ability to get online outside your house – were considered important by a smaller number of respondents, 57.6 percent and 41.1 percent respectively.

Table 14: Which of the following do you consider important about Internet service?

Reliability of Connection	90.8%
Connection Speed	89.5
Price	81.7
Service Provider	67.6
Ability to get online outside house	41.1

Several added comments about reliability and speed. One pointed out that reliability is very important because the respondent takes online classes and does banking online. Several noted that they would like to stream videos, access other services such as online games but speed is too slow. "We try [to download music or video], but it never works." "When we do stream video, it's really slow, always cuts on and off."

One respondent said that Internet subscriptions cost too much while raising children, and that "not many people in the village have Internet." Another responded stated "it's sometimes impossible [to afford the Internet] unless you're well off." In Bethel, where higher speed service is already available, some respondents complained about the service being expensive, and usage caps restrictive. A Bethel resident said the family would like to use Xbox online and to stream video, but they already go over their usage limit, with their bill routinely exceeding $300 per month.

Price of Internet Access:

Internet users pay a wide range of charges for monthly Internet access, from less than $20 per month (apparently for dial-up service) to more than $100 per month. One third of subscribers pay between $50 and $80 per month. Some 30 percent of respondents with Internet service said they paid more than $100 per month, with the highest number in Bethel (48 percent of subscribers) and Dillingham (37.5 percent).

About 57 percent of satellite users paid between $50 and $80 per month, with an additional 21 percent paying more than $100 per month for broadband speeds of 1.6 mbps or more.

Reasons for Not Having Internet Service:

Among those who do not subscribe to the Internet at home, the most important factor listed in all regions was cost. Additional factors cited were concerns about privacy, availability of Internet elsewhere in the community, and reliability and availability of Internet service.

Table 15: Reasons for not subscribing to Internet service

Cost of Internet service	66%
Concerns about privacy	52
Can use Internet elsewhere	49
Internet not reliable	42
Internet not available	42
Did not have computer	30
Computer could not support Internet access	17

Of those citing cost as a concern, the monthly charges for Internet service were by far the most important, cited by 87 percent.

Table 16: Most important costs of Internet service among nonsubscribers

Cost of monthly Internet service	87%
Cost of installation	58
Cost of computer or other equipment	53

Privacy Concerns:

Privacy remains an important issue for ICT users in southwest Alaska. Compared to providing personal information over the telephone, 40 percent said they were more concerned when using the Internet, while 47 percent were equally concerned about providing personal information on the phone or online.

10. Interest in Broadband

Intent to Subscribe at Home:

About 45 percent of respondents thought their households would sign up for broadband, while an equal number (46 percent) said they weren't sure, or "it depends…." There was little variation among education levels, with 40 percent of those with high school education saying they would subscribe, compared with 51 percent of those with college degrees. Those with post-high school vocational training was most likely to subscribe, with 67 percent saying they thought their household would sign up.

Among those who said "it depends," their primary concern was price (55 percent).

Table 17: Do you think your Household will sign up for Broadband?

	Bethel	Bristol Bay Borough	Dillingham City (plus Aleknagik)	Villages - Bethel/Wade Hampton/YK Census Areas	Villages - Dillingham and Lake & Peninsula Boroughs	Total
Yes	42%	42%	46%	49%	35%	45%
No	11%	4%	7%	6%	14%	8%
Don't Know/Depends	47%	46%	47%	45%	51%	46%
Of 'Don't Know/Depends':						
DEPENDS ON: Cost	87%	66%	55%	36%	59%	55%
DEPENDS ON: Packages/Available Services	17%	17%	14%	7%	5%	11%
DEPENDS ON: Connection Speed	4%		17%	12%	2%	9%
DEPENDS ON: Service Provider		8%	6%			1%
DEPENDS ON: Connection Quality	9%	17%	9%	3%	2%	6%
DEPENDS ON: Whether have a need for it	4%			14%	10%	9%

Intent to Use Broadband elsewhere in the Community:

Almost 60 percent of respondents said they thought they would use broadband somewhere else in the community when it was available, with the highest percentage (71 percent) from the villages in the Dillingham, Lake and Peninsula Boroughs region. This projection points to the need for community access to broadband through schools, libraries, and/or other locations.

Table 18: When broadband is available, will you use it elsewhere in the community?

Yes	60%
No	19
Not if I have to pay	2

Issues that Impact Decision to Subscribe:

About 8 percent thought their households definitely would not sign up for broadband. Those with less than high school education were more likely than others to say that they definitely would not sign up for broadband.

Among those who thought their households might not or definitely would not sign up for broadband, price was their overwhelming concern, cited by 72 percent. Only 16 percent of those who said "no" or "it depends" did not think their households had a need for it, although this percentage was higher in villages.

Table 19: Reasons may/will not sign up for Broadband

Price/cannot afford it	72%
Do not have equipment	27
Do not want/see need	16
Privacy concerns	14
Do not know how to use it	11
Worried about content	11

The concerns about equipment and skills were higher in villages, with 41 percent in villages saying that they did not have necessary equipment such as computers, and 16 percent saying they did not know how to use the Internet. These responses point to the need for digital literacy training, and for ongoing community access.

Broadband Applications:

Respondents were asked to identify broadband services they thought they or other household members would likely use. The top services listed were social networking, downloading music, downloading TV/videos/movies, and school or other education like online classes. Several of these are similar to services that Internet users said they do already, although likely much more slowly. However, playing online games and Internet telephony and video calling are services that few use now.

Table 20: How Household Members may use Broadband

Social networking	63%
Downloading music	60
Downloading video/TV/movies	56
School or other education	50
Playing online games	48
Video calls or conferencing, e.g. Skype	47
Work or telecommuting	40

Education appears to influence how people may use broadband. In general, predicted usage is higher among those with more education. While about 40 percent of those with less than high school education said they might use broadband for entertainment, only 15 percent thought they would use it for education. Again, these responses point to a need for community access and training in digital literacy.

Table 21: How Household Members may use Broadband by Education Levels

	Less than High School	High School / GED	Vocational or some college	4-year College Degree or higher	Total
-Social networking	39%	61%	73%	62%	63%
-School or other education like online classes	15%	45%	60%	63%	50%
-Download music	39%	63%	60%	60%	60%
-Download video/TV/Movies	39%	55%	58%	64%	56%
-Play online games	30%	51%	60%	31%	48%
-Work or telecommuting	26%	31%	44%	61%	40%
-Video calls or conferencing like with Skype	17%	43%	53%	59%	47%

11. Source of News

For comparison with NTIA studies, respondents were also asked about their sources of news. After pretesting, the topic was divided into two questions: news about their community and region, and news about the rest of Alaska and outside Alaska.

Personal communications and mass media remain important sources of information for TERRA region residents. The most cited source of news about their communities and the region was talking with friends/family/coworkers, followed by reading local newspapers/magazines, and listening to the radio. These responses show the ongoing importance of the "moccasin telegraph" to share local and regional information, and the role of local newspapers and community/regional radio stations.

Most important sources for news about the rest of Alaska and Outside were TV (68 percent) and the Internet (47 percent), followed by radio and print media. This ranking of sources more closely mirrored national responses.

Table 22: How do you get News?

	About Community and Region	About Rest of Alaska and Outside
Talking with friends/family/coworkers	61%	22%
Reading newspapers or magazines	57	29
From the radio	55	30
From TV	49	71
From the Internet	38	47

12. Comparison with National Data

***Mobile Phone Access and Use**:*

The following section presents some comparisons with national data, primarily from the NTIA's *Digital Nation* and from FCC reports.

Concerning mobile phones, about 87 percent of households in the TERRA region have at least one cellphone; nationwide, 86 percent of adults have cellphones. Thus, the percentage of TERRA region residents with mobile phones in the TERRA region is about the same as in the nation as a whole, and higher than in rural areas nationwide. It appears that TERRA region residents are more avid users of some applications such as text messages, accessing web pages, and downloading applications than U.S. cellphone users in general, despite the limited mobile bandwidth in the TERRA region. (Note that comparisons are not identical, with nationwide data for all adults, and TERRA region data for households.)

Table 23: Cellphone Use Nationwide and in TERRA Region:

	Nationwide: All adults[16]	**TERRA Households**
Percentage with a cellphone	86%	87%
Percentage of those with cellphone who:		
Send or receive text messages	66	83
Send or receive pictures	52	41
Send or receive email	26	37
Send or receive Instant Messages	28	N/A
Access Web pages on the Internet	28	51
Get a map or directions to another location	27	22
Download an application to your cell phone	20	41
Download or stream music or video	17	22

Reasons do not Subscribe to Broadband:

TERRA region residents appear to be much more concerned about price of broadband than others across the U.S. who do not subscribe to broadband. As noted above, 72 percent of TERRA residents cited price or affordability as the main reason they may not or will not sign up for broadband, followed by 26 percent concerned that they did not have the necessary equipment at home, and 15 percent who did not want or see the need for broadband.

At the national level, among non-Internet users, 47.2 percent said they were not interested in broadband, 22.3 percent did not have computers or had inadequate computers, and 18.6 percent thought broadband would be too expensive. Among those with dial-up at home (who may be

closer to most TERRA region respondents, 37.1 percent of rural residents thought broadband was too expensive, while 18.8 percent were not interested.[17]

Table 24: Reasons may/will not sign up for Broadband: National and TERRA Region

	TERRA Region Users	National Rural Dial-up Users	National non-Internet Users[18]
Price/cannot afford it	72%	37.1%	18.6%
Do not have equipment	26	0.2	22.3
Do not want/see need	15	18.8	47.2
Privacy concerns	14	0.4	0.3
Do not know how to use it	10	0.4	4.3
Worried about content	10		

Use of the Internet Elsewhere in the Community:

Residents in the TERRA region are more likely to use community access facilities such as schools, libraries, and community (or tribal) centers than rural residents across the U.S.

Table 25: Use of Public Access Facilities: National Rural and TERRA Region

	National Rural[19]	TERRA Region
Library	34%	32%
School	22	60
Community center	13	14
Church	4	N/A
Tribal office	N/A	31

13. Internet Use by Businesses and Organizations

In order to understand how businesses and organizations in the region currently use the Internet and how broadband may impact economic activities, we interviewed approximately 25 organizations including seafood processors, small businesses, a bank, a regional air service, tourist lodge, village Tribal councils, and Native organizations. We also reviewed transcripts of interviews conducted by SWAMC (Southwest Alaska Municipal Council) as part of its broadband strategy project.

We did not contact schools or health service providers, as they already receive federally subsidized broadband. However, ISER will collect data on use of broadband services at libraries in the TERRA region as part of its evaluation of the OWL (Online with Libraries) program.

Tribal Councils and other Native Organizations:

Tribal councils and other Native organizations in the region are major Internet users, but point out that there are often problems with slow speed and outages. Some have installed their own VSAT systems. Several were concerned with reliability problems such as latency and outages during bad weather on VSAT networks.

Several said their work depends on Internet access; one Tribal council member said they "depend on it more and more on the Internet to carry out the duties of the Tribe." Email is critical to communicate with their board of directors, with villages, with consultants, etc. Online access is also important for submitting grant proposals and filing reports on grants and other funding. It is difficult to download documents and useful software. One said that working at the desk with clients is difficult because of the slow upload and download of necessary forms and information. Some said they receive numerous documents electronically, but that the people they work with in the villages have very unreliable and slow connections and small mailboxes.

One representative said cloud-based downloads can take hours. A regional Native organization sends their newsletter to Anchorage for printing, and said that uploading the electronic version to send to the printer can be extremely slow. They also want to participate in web conferences and offer online training to employees in their field offices. Some other organizations do not allow webstreaming for training because they have bandwidth.

A Tribal Council representative said he thought the impact of broadband would depend on how each organization decides to use it. "High speed internet could possible help improve communication between our local office and the federal grant/funding agencies. The way we use it now makes reporting a lot easier with the federal government in a lot of ways…. I can see broadband might be able to improve communication between agencies that we seek money from such as the Denali Commission, Fish and Game, CDQ programs, our regional corporation - possibly bring in more business to our area." However, he was concerned about skills and the need for training: "How will I get staff up to date on the new equipment? Will they need to take a class on how to efficiently use the Internet service or broadband?"

He also thought broadband might help improve communications between local service organizations and the health corporation and other social services in the region. He pointed out that their community "is in a tough spot because we're so far away from the central location where we get our services from in the Kuskokwim/Bethel region. Even our nonprofit AVCP is out there and we often don't know what's going on there."

Fisheries:

Seafood processors in the Bristol Bay region hire thousands of seasonal employees to work both on shore and in offshore fish processing vessels. One company said they employ 4000 to 5000 seasonal workers each year. Some are stand-alone seasonal operations; others have seasonal facilities in Bristol Bay and elsewhere, with head offices typically in Washington State. Several seafood processors have installed their own VSATs for Internet access. Online office uses include email, sending accounting and payroll information to head office, and interacting with customers

and suppliers, as well as general web access. They also transmit e-ticket fishing data to the State government. Some use cloud-based services that are difficult to reach for file backup and access to software.

Generally, they find satellite service slow, with frequent outages, but preferable to available terrestrial services. One operates a Virtual Private Network (VPN) through AT&T with last mile connection from the local phone company. They all state that faster and more reliable Internet access would save time and improve efficiency. Cell phone use for business is generally confined to voice calls. Complaints include limited bandwidth from local mobile service providers and lack of roaming from major operators used by headquarters staff such as AT&T and Verizon.

Some fish processors provide Internet connections for seasonal employees, ranging from an Internet room or cafe, to widespread coverage of the premises with free WiFi, to renting modems to employees in other locations with better service, to limited pay-for-use services. Some workers bring smartphones and tablets that can access WiFi. Seasonal employees visit the public library for online access, but library facilities may be limited in summer. One manager thought that access to broadband would be a real "morale booster" for seasonal employees.

Fixed wireless that could reach offshore could be useful to seafood processors. Large companies with operations at several locations in Alaska said that their vessels are equipped with satellite terminals, but that marine satellite service is expensive. They noted that processing vessels are often only one to three miles offshore, and that they would definitely use terrestrial broadband if it were available both for business communications and for personal use by employees living onboard for extended periods. They would also use group email to send updates to the fleet on relocation, fishing opening and closing times, etc. One manager thought communication to the boats could also be used for direct marketing with customers. He said now the only way to reach the 200 fishing boats with mission-critical information is to make cell phone calls to each one individually.

Some independent commercial fishermen use the Internet extensively; they may also have VSATs at home for business as well as family use. One noted that the ability to access the Internet while traveling is very important for fishing and rural jobs.

Banking:

A manager of a regional branch of a major bank said businesses in the region can be hampered by lack of adequate Internet connections to take advantage of many of the tools of e-banking such as remote deposit, which allows customers to scan and email checks without mailing. Also, downloading of software can be problematic. Businesses are stuck using old-fashioned practices, so that there are no cost savings or "lean operations." Banks want to know who they can help businesses, but many solutions are stymied by inadequate broadband. The bank representative said that when working with clients in their offices, he often needs to call to Anchorage for customer service rather than use online tools. Also, unconnected customers are difficult and expensive to serve, requiring duplicative systems. He noted that some customers are interested in using smartphones to make payments (m-banking); however, smartphone use is limited because of slow mobile networks except where they can use WiFi.

Air Services:

An air service based in Bethel uses the Internet for several purposes. The flight coordinator said that he uses the Internet to check weather before dispatching planes using NOAA's Automated Surface Observing System (ASOS, an automated weather service which gives updates every 10 minutes), looking at web cams in communities that have it for local weather, and following flights with Flight Fleet Asset View which allows him to follow flights online. To serve local business in Bethel, the air service has Internet-based charter and YKHC travel requests. Passengers can also arrange Medicaid travel online.

Tourism:

There are numerous lodges in the Bristol Bay region that cater to sports fishing guests from outside Alaska who provide revenue for several months during the fishing season. The lodges generally rely on websites, phone contacts and email to generate business. One lodge manager stated that voice communication is only by cellular service from Bristol Bay Telephone that is not very reliable. The lodge has a satellite terminal for Internet access with limited bandwidth for email communication. They would definitely upgrade to terrestrial broadband, but he has been told that the lodge is outside the range of planned last mile service. Improved communications would be useful both to make sure that potential customers can reach them, and to provide more online services for staff and guests.

Small Business:

Small businesses interviewed included legal and accounting services, an automobile repair shop, and retail stores. The auto mechanic said the Internet helped him to repair vehicles, as he was able to look up online service manuals and other documentation.

A local business owner said they use their satellite Internet connection for their lodge, store and fuel store. He said few other businesses in the community use the Internet.

A staff member of a Native organization noted that they want to get into more web-based applications designed for small and medium-sized businesses such as online QuickBooks. However, when several people get online in their office, access is extremely slow, and there is a great loss of productivity: "We feel we are back in the 90s. It turns a two-minute task into 20 minutes."

Economic Development:

Representatives of Native organizations and businesses pointed out that broadband will be important for economic development. "We are pushing for tourism in rural Alaska. Broadband is necessary for tourism for both vendors and visitors." One organization is trying to help local people who want to do websites to sell fish products, arts and crafts, but "trying to develop tools and designs for web marketing using limited bandwidth is challenging."

14. What Difference may Broadband make in the Region?

Since broadband is just being introduced in southwest Alaska, we can only suggest what its future impacts may be. One indication is from respondents who stated how they may use broadband. Personal connections and entertainment ranked highest (social networking, downloading music and video, playing online games). However, 48 percent said they expected to use broadband for education, 45 percent said they would use Skype or similar services for video conferencing, and 39 percent said they would use broadband for work or telecommuting. The interest in education and telecommuting indicate that broadband could help residents upgrade their education and work from their homes or communities.

Another indication of potential uses of broadband is the experience from current satellite service subscribers, who have chosen to upgrade to higher speed Internet service than is currently available from local carriers. Some 88 percent of satellite users accessed government services online, 87 percent accessed financial services, while 68 percent used the Internet for education, and 62 percent for work or telecommuting. These "early adopters" of the fastest connections available provide some indication that future broadband users will take advantage of broadband for work, education, and public and private sector services not available in their communities.

Others thought they would benefit from online banking and reservation services. Some thought that online shopping would allow them to buy cheaper goods than were available locally, but that there could be a negative impact on local stores that would lose business once people knew online ordering was cheaper and the service proved to be reliable.

Respondents from Native organizations commented that broadband could save them time in accessing online information and software compared to time required using current Internet services, and would be beneficial in applying for grants and filing reports with funders, and helping Tribal members applying for jobs. Some also noted opportunities to offer training in villages, and to help local entrepreneurs develop websites to sell crafts and other products.

The tourism industry also requires reliable communications to support their operations and build their businesses. Fishing lodges and other wilderness tourism businesses rely on telephone and email to respond to potential customers, and websites and travel agencies to attract business. Similarly, businesses in hub communities use online services to attract customers and manage their operations.

The seafood processing industry would definitely benefit from faster connectivity to run their back office operations, such as uploading catch information, payroll and other accounting data, and using other software for their business. They also represent a source of many new customers in the thousands of seasonal workers they hire for up to four months who want to use the Internet to keep in touch with family and friends and to access entertainment. Broadband wireless connectivity to boats and processing vessels in Bristol Bay would be used both to keep crews up to date on operations, as well as to provide personal broadband access for crews and seasonal employees. These applications for logistics and back-office communications as well as for personal use by employees are also likely to apply to the mining and petroleum industries.

However, reliable communications remain necessary but not sufficient for rural economic development. As one respondent put it: "I think right now they're a lot of other important factors that could improve our economy … such as access to property and making inexpensive loans available for residents."

15. Conclusions

Mobile Use and Demand: Mobile phone use is very widespread. Besides voice calls, the most popular use of cellphones is for texting (which requires very little bandwidth). However, many residents now own smartphones that provide some Internet access over 2.5 G networks or WiFi, and are eager to get Internet access on these and other mobile devices.

Internet Use: Many Southwest Alaska residents including village residents already use the Internet either at home or at work or school. Two-thirds of those who access the Internet are online every day or almost every day.

Internet Applications: While applications for social networking entertainment are very popular, the Internet is also used extensively for education (schoolwork or distance education), online shopping, and accessing government forms and services. Respondents indicate that the connections are too slow for some online course requirements, and that users sometimes have difficulty downloading forms or using other online services.

Interest in Broadband: About 45 percent of residents interviewed said their households would definitely subscribe to broadband service. Only 8 percent thought they definitely would not. The remainder said "maybe" or "it depends…." Price was their primary concern.

Cost: Internet subscriptions can require a significant commitment of disposable income in regions where unemployment is high and much paid work is seasonal. Among those who do not subscribe to the Internet, the most cited reason was monthly subscription cost. Monthly cost is also the key concern among those who are not sure or not likely to subscribe to broadband.

Community Access: Residents of towns are more likely to have Internet service at home than those in villages, but use of the Internet outside the home is widespread, most commonly at schools or at work, also at libraries and Tribal offices. Many of those with Internet service at home also go online elsewhere in the community, and 60 percent think they will use broadband outside the home. Concerns about price of monthly service also indicate that availability of broadband at schools, libraries, or other community locations will be important to ensure access.

Digital Literacy: Some residents, particularly in villages, state that they do not have the necessary equipment or skills to use broadband. Thus, digital literacy training and technical support will likely be necessary if rural Alaskans, particularly those living in remote villages, are to benefit from broadband.

IT Employment: Concerns among both residents and organizations serving villages about need for digital literacy training and technical support indicate that there will be a need for more technical support workers, particularly in villages.

Productivity: Commercial businesses and nonprofit organizations all stated that broadband would be very beneficial in improving their productivity.

Funding and Jobs: Regional nonprofit organizations and Tribal councils said that broadband would help them to access funding and training opportunities that are otherwise not available. Such opportunities could enable them to expand their services and hire additional employees.

Seasonal Employment: Seafood processors and tourist lodges are major employers of seasonal workers who would use broadband to stay in touch with family and friends, and for entertainment. Costs of access would be paid either by the employer or by individual employees.

Regional Information: Interpersonal communications (the mukluk telegraph), local papers, and radio remain the most important sources of local and regional news.

Comparison with National Studies: While rural Alaskans are quite similar to other Americans in their current use of the Internet and aspirations for broadband, there are some important differences. A higher percentage intend to sign up for broadband than in other rural regions. However, price is a more dominant concern among rural Alaskans. More rural Alaskans access the Internet and plan to access broadband elsewhere in their community, even if they subscribe at home.

NOTE: Part 2 of this study consists of a literature review that provides an extensive bibliography and provides key findings from research conducted elsewhere that are relevant for Alaska.

TOWARD UNIVERSAL BROADBAND IN RURAL ALASKA

PART 2. LITERATURE REVIEW: BROADBAND FOR ALASKA DEVELOPMENT

A Report of the Institute of Social and Economic Research
University of Alaska Anchorage

Principal Investigator: Heather E. Hudson

ISER Contributor: Kyle Wark

November 2012

Support for this research came from Connect Alaska with funding from the National Telecommunications and Information Administration (NTIA) for the work of the State of Alaska Broadband Task Force, with additional support from GCI.

LITERATURE REVIEW:
BROADBAND FOR ALASKA DEVELOPMENT

At the request of members of the State Broadband Task Force, we have prepared a literature review concerning the role and impacts of broadband in social and economic development. The review lists references under the following headings:

- Economic Analyses and International Organization Studies
- Rural and Regional Development
- Alaska and the North
- Adoption
- Sector Studies:
    - Education and Libraries
    - Health Care
    - E-Commerce, Rural Business and Natural Resources
    - E-Government
    - Public Safety and Disaster Communications

We have attempted to highlight references relevant to Alaska, with a focus on rural, remote, and northern regions, and on sectors important to the Alaska economy. In general, references are from the period 2005 to the present, although some earlier studies that appear highly significant are included. Some studies listed under one heading include several topics (such as education and healthcare as components of rural development).

It is important to note that the references listed are illustrative and not exhaustive. Many more publications are available on each of these topics. The bibliography includes the National Broadband Plan because it refers to many potential benefits of broadband included in the sector analyses, but it does not include policy documents such as FCC Notices and accompanying filings. It also does not include a complete list of State broadband plans. Links to many of these can be found on the Alaska Broadband Task Force homepage.

References to authors in the text refer to full citations in the bibliography.

International Comparisons

International organizations such as the International Telecommunication Union (ITU) and Organization for International Cooperation and Development (OECD) collect national data on broadband availability and pricing (see OECD 2011). The OECD reports on its membership, which is comprised primarily of industrialized countries, while the ITU reports on all of its more

than 200 member states. The World Bank has also published data and case studies on information and communication for development (IC4D) (see World Bank 2009 and 2012).

OECD data for 2011 rank the U.S. 15th in broadband subscriptions per 100 inhabitants at 27.7 percent. All northern countries except Russia rank higher: Denmark (37.9%), Norway (35.7%), Iceland (34.6%), Sweden (32.5%), Canada (32.0%), and Finland (29.6%).[1] Of course, these are national data, and do not reveal disparities within countries. However, with the exception of Greenland, broadband access is widespread throughout these countries. Finland, which has declared Internet access a human right, is extending broadband to all, including its northern regions.[2]

The ITU has just published *The State of Broadband 2012: Achieving Digital Inclusion for All*, a report published for the UN Broadband Commission, which it cochairs with UNESCO (ITU, 2012). The report includes data on broadband penetration in all its member states, and case studies on digital inclusion, making broadband affordable, and getting people online.

The ITU (2007) has created a Digital Opportunity Index (DOI) based on 11 information and communication technology (ICT) indicators, grouped in 3 clusters: opportunity, infrastructure and utilization. The Digital Opportunity Index measures these aspects, including price and affordability of ICTs (including Internet and mobile) relative to average income. According to this index, South Korea ranks first, and the U.S. ranks 20th. Other northern countries rank higher than the U.S.: Denmark 3rd, Iceland 4th, Sweden 9th, Finland 11th, Norway 12th, and Canada 17th.

Economic Analyses and National Studies

Numerous economic analyses have attempted to quantify the contribution of broadband to economic growth, primarily measured by GDP. While these studies can point to potential outcomes of broadband investment, most focus at the national level, and particularly on industrialized economies (such as the U.S. and other OECD countries). Alaska's economy and remote indigenous population have more in common with some developing countries. However, broadband investment in developing regions remains limited to date.

Researchers have taken several approaches to analyze the impact of telecommunications, and more recently, broadband, on economic development. Macroeconomic studies have analyzed multiyear and multi-economy data sets, typically examining communications infrastructure investment and GDP growth or employment. Microeconomic studies at the firm level have examined broadband impact on productivity and growth in sales or revenues. Case studies have also examined impacts in various sectors or industries.

[1] OECD data for December 2011. Accessible at http://www.oecd.org/internet/broadbandandtelecom/oecdbroadbandportal.htm

[2] Personal communication, Kirsti Westphalen, Consul General of Finland in Los Angeles, September 2012.

An example of the macroeconomic analysis approach is a recent World Bank econometric analysis of 120 countries showed that for every 10-percentage-point increase in the penetration of broadband services, there is an increase of in 1.2 percentage point increase in per capita GDP growth in high income economies, and 1.38 percentage increase in developing countries. (2009).

In a report for the ITU, Katz (2012) summarizes the main findings:

> A review of the research on the economic impact of broadband indicates multiple effects. First and foremost, the evidence is fairly conclusive about the contribution of broadband to GDP growth. While the amount of this contribution varies, the discrepancies can be related to different datasets as well as model specifications. Secondly, broadband has been found to have an impact on the productivity at the firm level. Evidence generated both at the micro-economic and macro-economic level appears to confirm this effect. In addition, research has been successful in identifying the existence of a critical mass, indicating the existence of increasing economic returns of broadband penetration. On the other hand, consistent with the research at the ICT level, broadband economic impact could be mediated by a lag effect, indicating that adoption does not automatically translate into growth but that it would require the accumulation of intangible capital, defined as the changes in business processes and firm culture that lead to assimilation of improved business processes.

He notes that broadband can contribute to employment growth both as a result of infrastructure construction and spillover effects on the rest of the economy, particularly in sectors with high transaction costs such as financial services, education, and health care. Numerous studies have also identified consumer surplus in the form of benefits to the customer not captured in GDP data such as transportation savings and access to entertainment and social services. These are typically measured as the difference between what users are willing to pay for broadband and prices of broadband services.

However, Katz also notes several caveats:

> First, broadband exhibits a higher contribution to economic growth in countries that have a higher adoption of the technology…. Second, broadband has a stronger productivity impact in sectors with high transaction costs, such as financial services, or high labour intensity, such as tourism and lodging. Third, in less developed regions … broadband enables the adoption of more efficient business processes and leads to capital-labour substitution and, therefore loss of jobs…. Fourth, the impact of broadband on small and medium enterprises takes longer to materialize due to the need to restructure the firms' processes and labour organization in order to gain from adopting the technology …. Finally, the economic impact of broadband is higher when promotion of the technology is combined with stimulus of innovative businesses that are tied to new applications. *In other words, the impact of broadband is neither automatic nor homogeneous across the economic system*. This emphasizes the importance of implementing

> public policies not only in the areas of telecommunications regulation, but also in education, economic development and planning, science and technology, and others. (italics added)

This research grew out of numerous studies on the role of telecommunications in socio-economic development beginning in the late 1970s (see Hudson 2006). In general, time-series analyses showed that while economic development contributed to telecommunications growth (countries with higher GDP had higher investments in telecommunications and other infrastructure), there was a small but significant contribution of telecommunications to economic development (investment in telecommunications led to higher GDP per capita). With the rapid diffusion of mobile telephony in the developing world during the last decade, researchers have attempted to quantify its impact on economic growth. A study by Waverman et al. (2005) examined the impact of mobile phones in developing countries, and concluded that differences in the penetration and diffusion of mobile telephony certainly appear to explain some of the differences in growth rates between developing countries.

A review by Holt and Jamison concludes: "The lesson from the US appears to be that broadband has a positive economic impact, but that impact cannot be analyzed with any precision." They note that "One of the difficulties learned from studies of the effects of ICT is that impacts evolve.…"

This conclusion is perhaps most relevant for Alaska, as is Katz's comment that "the impact of broadband is neither automatic nor homogeneous across the economic system." Forecasting overall economic impact of universal broadband in Alaska is challenging, given the structure of the Alaska economy, with its dependence on natural resources and on public sector services. However, research on rural development and case studies of sectors relevant to Alaska provide insights about potential impacts. These are reviewed in the sections below.

Rural and Regional Development

Hudson (2006) states that telecommunications can contribute to socio-economic development in general and rural development in particular, through improving:

- Efficiency
- Effectiveness
- Equity, and
- Reach.

All of these are relevant to the Alaska context. In the TERRA survey, managers of Native organizations, rural industries such as seafood processing, and rural tourism businesses in southwest Alaska all stated that broadband would make their work more efficient, saving them time in applying for grants and filing online reports and business data; keeping track of inventory, boats or aircraft; and managing their operations.

Effectiveness refers to the quality of services provided. In education, for example, online courses and other content can improve the quality of education available in small village schools. Remote students taking University of Alaska distance education courses say they need broadband to participate more effectively in the online activities and interaction. Use of telemedicine

facilities improve the quality of village health care by making it possible for physicians at regional hospitals to diagnose and recommend treatment for village patients, and by sending patient data and test results electronically rather than waiting for hardcopies.

Equity-related benefits in Alaska result from reducing the distance barriers between rural and urban communities by providing access to information, entertainment, education, shopping and other services that are not otherwise available remote communities.

Reach refers to the ability of Alaskans to extend their markets electronically to market Native crafts, fish and other products, wilderness recreation and tourism, and other local assets.

Studies of the impact of broadband in other rural regions can provide some indications of potential impact in Alaska. Shideler et al. (2007) found in Kentucky that broadband deployment had a significant impact on a region's employment growth.

> Broadband infrastructure appears to reduce costs and/or increase market access, and thus lead to job creation and growth in total employment. At the sectoral level, broadband deployment positively impacts mining; construction; information; and administration, support, and waste management and remediation services. Broadband deployment does contribute to employment growth within real estate, rental, and leasing; arts, entertainment, and recreation; and other services; however, for these three sectors, other economic variables appear to be more influential to job growth than the availability of broadband…. Weak evidence suggests that broadband availability may positively impact retail trade; professional, scientific, and technical services; and health care and social assistance, though the impact is likely to be indirect given the supporting nature of these industries to the economy.

A study on *Broadband Internet's Value for Rural America* by the U.S. Department of Agriculture (Stenburg et al. 2009) focuses on agriculture, but some of its findings appear relevant for Alaska. Their analysis of farm use of broadband supports the hypothesis that people embrace terrestrial broadband when given the option. They suggest that as farm operators "increase their participation in e-commerce, their relationships with local suppliers are likely to weaken. Farm operators may increasingly opt for distant suppliers to secure lower prices or better access to niche inputs. Suppliers with an established Internet presence, including local ones, would appear better positioned to retain customers within the local economy." They also find that household characteristics such as age, education, presence of children, and household income are significant factors in adopting broadband Internet use. Generally, rural economies benefit from broadband availability: "In comparing counties that had broadband access relatively early (by 2000) with similarly situated counties that had little or no broadband access as of 2000, employment growth was higher and nonfarm private earnings greater in counties with a longer history of broadband availability."

In reviewing research on broadband and rural development for the Alberta government, Irshad (2009) concluded:

- Development of a community of broadband users requires more time, support, and investment than is usually anticipated.
- Technology training is a necessary component for adoption and deployment of broadband in rural communities.
- The best community developments are led by the community itself – specifically those local early adopters and champions – and not by outside enthusiasts or technologists.
- E-learning is a growing market but e-shopping, communications and entertainment are the primary drivers of domestic broadband take-up.

A study by Kolko (2010) for the Public Policy Institute of California found that the relationship between broadband expansion and employment growth varies across industries, and that the positive relationship is especially large for utilities; information; finance and insurance; professional, scientific, and technical services; management of companies and enterprises; and administrative and business support services. He also noted that the relationship between broadband and employment growth is also stronger in places with lower population density, "consistent with the theory that smaller or more isolated areas may benefit more from high-speed connections, giving businesses in these areas access to larger markets. However, even for most high density areas, the relationship between broadband and growth remains positive on balance, just not as large as for lower-density areas." His conclusion appears relevant for rural Alaska: "None of the other place characteristics—such as having a more educated workforce, having a better climate, or being a vacation destination—affects the relationship between broadband expansion and employment growth."

The North

Experience from across the North, particularly from Canada, provides valuable insights for Alaska, in terms of broadband planning for remote areas and services provided by and for indigenous populations.

In 2011, a Canadian Arctic Communications Infrastructure Assessment (ACIA) was completed to identify "the issues and challenges facing governments and service providers in ensuring the Canadian Arctic is properly connected for the benefit of Arctic citizens and all Canadians." The realities they cite that have led to the state of Canadian Arctic infrastructure are similar to those in Alaska:

> 1. The geographic facts make the entire Arctic region challenging from an economic perspective for building, maintaining and evolving communication services that meet users' needs at an affordable price, without significant public investment;
> 2. The existing network investment models in the North are not meeting the rapid pace of increasing change and convergence of communication services available in the South.
> 3. There is currently no comprehensive strategy for connecting all Arctic communities to the level of service required within communities or between communities. (Imaituk, 2011)

The assessment reviews existing telecommunications capacity, problems, technology options, and requirements, primarily for government services in Arctic communities. It also includes

maps showing which services are available in each community in the Canadian Arctic, as of February, 2011. Among its recommendations are:

- Commit to service parity among Arctic communities, and set minimum connectivity standards for all Arctic communities that assure service parity to southern urban centers.
- Investment strategies for Arctic communication networks must include provisions for the increasing rate of change of technology, and the continuous introduction of new consumer services and devices.
- Investment models should allow for, and encourage competing services in as many market segments as possible, thereby promoting consumer and government choice, and innovation and improved services.

This report could serve as a template for much of the material required in an Alaska broadband plan. It is interesting to note that the unit of analysis the ACIA uses is the community rather than the household, to achieve "parity to southern urban centers."

There are several examples of indigenous entities providing broadband capacity and services in Canada. Qiniq (meaning "to search") is a network delivering broadband connectivity to 25 communities in Nunavut in the Canadian Arctic. As in most of Alaska, in Nunavut there are "no highways, no power or phone lines, no fibre optic networks, and no microwave relays linking communities" and the most common method of supplying communities with goods is air or barge. The Nunavut Broadband Development Corporation (NBDC) was formed to establish Internet services in Nunavut communities; participants included Nunavut government officials, Inuit organizations, and private sector companies. Initial federal government funding enabled the NBDC to produce a business case for broadband in Nunavut and to build some of the infrastructure. Qiniq states that the cost to build the Nunavut network with satellite distribution and local fixed wireless was $9 million. Qiniq also provides local support, with each community having a community service provider, a local person who was trained to "install wireless modems, handle basic troubleshooting, and involve people in the initiative." Involving local people was seen as one of the key factors in achieving success. (Qiniq, 2012)

Another network serving remote northern communities is K-Net (the Kuh-ke-nah Network), an aboriginal-owned community ICT network that provides access to the Internet to Cree and Ojibway communities in northern Ontario. These remote communities are similar in isolation (no road access) and size (300 to 900 people) to Alaska Native villages. K-Net contracts with carriers to provide bandwidth for communities, and helps communities to establish local ISPs. It also contracts with health care providers to provide telehealth networks, and with the Ontario Ministry of Education to support an online high school (Keewaytinook Internet High School -- KIHS) through which students in remote communities can complete their GED. K-Net also provides computer training and skills development for community members and community networking. K-Net also manages a satellite-based network providing videoconferencing services to Native communities in northern Ontario, northern Quebec, and northern Manitoba. K-Net videoconferencing facilities are also used for social gatherings to link elders in remote Northwestern Ontario villages. (See www.knet.ca and Fiser and Clement, 2009)

The Ktunaxa Nation Broadband Network is located in southeastern British Columbia, and was originally conceived to disseminate the disappearing Ktunaxa language. It has utilized the

FirstVoices initiative, which "is a suite of web-based tools and services designed to support Aboriginal people engaged in language archiving, language teaching, and cultural revitalization." Community learning centers (CLCs) operate in Ktunaxa Nation communities resulting from a partnership with the University of British Columbia (UBC). (Slonowski, 2008).

Another Native-owned communications provider is GwaiiTel, which makes high-speed Internet service available to residents of seven communities of Haida Gwaii (Queen Charlotte Islands). GwaiiTel was formed by the Gwaii Trust, a nonprofit organization established to enhance environmentally sustainable social and economic benefits to Haida Gwaii/the Queen Charlotte Islands through its perpetual trust fund. *Connection to the mainland is over North America's longest over-water radio link for Internet transmission. GwaiiTel invested more than $1 million (Canadian) to build infrastructure connecting the islands' communities, with funding from the Gwaii Trust Society and a grant from* grant from Industry Canada's Broadband for Rural and Northern Development Pilot Program (BRAND).

"K-Net, Ktunaxa, and Qiniq are powerful examples of Aboriginal organizations taking control over the *what* and the *how* by responding to the realities of the communities, and strengthening them in the process. K-Net started as a response to the need to maintain contact with the youth that left the communities to further their education, Ktunaxa was born by the concern of the loss of the traditional language, and Qiniq emerged from the vision of a practical initiative to decrease the isolation of the communities." (McMahon, 2011) GwaiiTel is another example of a Native initiative to provide broadband to isolated northern Native communities.

Hudson (2011) compares telecommunications policies concerning rural and remote regions in the U.S., Canada and Greenland. Greenland now has submarine fiber links to Europe via Iceland and to North America via Newfoundland, and is upgrading local access, but prices remain high. In Canada, there is a relatively small high cost fund, but nothing comparable to the U.S. E-Rate program. In 2011, the Canadian Radio-Television and Telecommunications Commission (CRTC), which is comparable to the FCC, stated that broadband users should be able to "stream higher-quality audio and video and to participate in video conferencing at reasonable quality using online services. This capability will enable users to engage in such activities as participating in distance learning and online consultations with professionals (basic e-health)." To accommodate such uses, the CRTC set a target for broadband access of a minimum of 5 Mbps download and 1 Mbps upload. The CRTC noted that "while many Canadians in urban areas already have access to broadband Internet services at or above these target speeds, such speeds are not currently available to most Canadians in rural and remote areas." It also stated that target speeds are to be actual speeds delivered, not merely those advertised. It expects that "the target speeds set out above will be available to all Canadian homes, regardless of their geographic location, through a range of technologies" by the end of 2015. (CRTC, 2011)

Adoption

The *Digital Nation* series of studies by the Economics and Statistics Administration and the National Telecommunications and Information Administration (NTIA) in the Department of Commerce provide detailed analyses of broadband adoption in the U.S., with data disaggregated for many variables including ethnicity, age, education, income, and urban vs. rural location. (NTIA 2010, 2011). In 2011, about 7 out of 10 households in the U.S. were broadband

subscribers. The analysis found a strong correlation between broadband adoption and socio-economic factors, such as income and education, but that these differences did not explain the entire broadband adoption gap that exists along racial, ethnic, and geographic lines. "Even after accounting for socio-economic differences, certain minority and rural households still lag in broadband adoption." The most important reasons households without broadband Internet or dial-up service gave for not subscribing were lack of need or interest (47 percent); lack of affordability (24 percent); and inadequate computer (15 percent). Households reporting affordability as the major barrier to adoption cited both the fixed cost of purchasing a computer and the monthly subscription costs as important factors.

Another national study was carried out by Horrigan (2009) as part of the FCC's research for the National Broadband Plan. At that time, about 65 percent of Americans used high speed Internet at home. There were three primary reasons why the 35 percent of non-adopting Americans did not have broadband: cost, lack of digital literacy, and broadband was not sufficiently relevant for them to purchase it. The main dividing lines were socio-economic, particularly income and education. Horrigan also provides data on adoption among various ethnic groups, seniors, and people with disabilities.

As noted in the introduction to our TERRA study report, these studies provide many valuable insights, but their sample for Alaska is small, and the data on rural Alaska are too limited to be useful.

Other research has examined various barriers to adoption. Some case studies had similar findings on adoption to the national studies. LaRose et al. (2011) found in Kentucky: "Prior experience with the Internet, the expected outcomes of broadband usage, direct personal experience with broadband, and self-efficacy had direct effects on broadband intentions. Age and income, but not education or ethnicity, also had direct impacts." They conclude: "Public education efforts in a community participating in the ConnectKentucky initiative had an incremental effect on broadband adoption by positively affecting residents' perceptions of broadband service."

A report on broadband adoption in low income communities prepared for the FCC by the Social Science Research Council concluded that:

- Broadband access is increasingly a requirement of socio-economic inclusion, not an outcome of it -- and residents of low-income communities know this.
- Price is only one factor shaping the fragile equilibrium of home broadband adoption, and price pressures go beyond the obvious challenge of high monthly fees. Hardware costs, hidden fees, billing transparency, quality of service, and availability are major issues for low-income communities.
- Libraries and other community organizations fill the gap between low home adoption and high community demand, and provide a number of other critical services, such as training and support. (Dailey et al., 2010)

Concerning communications in tribal regions, Mark Goldstein of the United States Government Accountability Office (GAO) testified before the U.S. Senate Committee on Commerce, Science, and Transportation that lack of telecommunications training and knowledge

among tribal members is a barrier to improving their telecommunications. He quoted a tribal official who stated that: "tribes without technically trained staff would be at a disadvantage in negotiating with service providers. This official added that having tribal members trained in telecommunications was necessary to ensure that a tribe's planned improvements included the equipment and technology the tribe wanted and needed." (Goldstein, 2006)

Goldstein noted that some tribes are addressing the shortage of technically-trained tribal members to plan and implement improvements on tribal lands through mentoring and partnerships with educational institutions. Examples include the Yakama Nation that proposed to connect a local university to its telecommunications system in exchange for technical training for its staff, and The Mescalero Apache Tribe, which "improved its technical capacity by hiring technically trained staff and pairing them with less trained staff, creating a technical mentoring program." (Goldstein 2006)

There have been many studies on models of community access. In developing countries, a telecenter often provides communications facilities for those without equipment or connectivity. Similar approaches have been used in other contexts such as "community online access centres" in Australia, and CTCs (community technology centers) in the U.S. Such centers often also provide training, and may include "infomediaries," resource people who can help users to find information as well as to use a computer. (Hudson, 2006)

Sector Studies

Education, Libraries, and Research

Alaska's experience with using telecommunications to support rural education dates from satellite experiments in the 1970's, which distributed first audio and then video educational content to village schools. In the 1980's, the LearnAlaska project produced some educational programs for villages, and delivered video content requested by teachers on the same transponder at night so that they could set the school VCRs to record the materials for future use. (See ISER 2011 and Hudson and Pittman 1999.) In the 1990s, village high school students were able to take some satellite-based telecourses delivered by regional and national educational consortia in subjects such foreign languages and advanced mathematics and sciences that were not offered in village schools. With the advent of the Internet, courses and research materials became available online. Schools added computers and sought to connect them to the Worldwide Web. Local libraries also became an important source of information from the outside world. Community residents without computers or connectivity could use library computers to send e-mail, do research for class projects, purchase goods available online, search for jobs, and find other information or connect with distant family and friends.

Distance education is important for Alaska at the K-12 level to augment capacities in rural schools, for access to post-secondary education and training in rural areas, and for continuing education such as for health aides, teachers, and public safety officials. Many studies have demonstrated that distance delivery can be as effective as in person instruction (see, for example, Bernard et al, 2004 and Daniel, 2005). In higher education, the University of Alaska delivers courses online to reach students unable to attend classes on campus, and leases broadband capacity to link its rural campuses to the main campuses. As more universities around the world

make courses available online, broadband will be the means by which Alaskans can take advantage of these new resources.

Libraries are a major resource for community access to computers and the Internet across the U.S. including in Alaska. Bertot (2009) points out that "... public libraries are in a perpetual cycle of planning and implementing various [public access] services and resources. Either hardware needs to be updated or replaced, or there is a software update that needs to be installed, or libraries are looking to the next technology coming down the road. In short, the technology planning to implementation cycle is perpetual." Users increasingly expect "a 'MyLibrary.com' experience that allows for seamless integration across the library's services but also facilitates the use of personal technologies (e.g., iPods, MP3 players, and USB devices). Thus users expect the library's services to resemble those services offered by a range of information service providers."

As noted in the TERRA survey report, both schools and libraries are important for community access in rural Alaska. While facing needs for frequent upgrading of facilities as pointed out above, they benefit from subsidies for connectivity from the E-Rate program, part of the FCC's universal service fund (USF). Typically, Alaska's schools and libraries qualify for subsidies ranging from 70 to 90 percent of the charges for connectivity. From 1998 through 2011, Alaska received more than $211 million from the E-Rate program, among the top states in per capita support in the country.[3]

Researchers in Alaska will also have increasing need for broadband. University researchers rely on connectivity to access information, share computing resources, and collaborate with colleagues around the world. The Alaska State Committee on Research (SCoR) has recently drafted a plan for the future of science and technology in Alaska that includes education and training for future innovators, research coordination, and improvements in telecommunications infrastructure among its priorities (Alaska State Commission on Research, 2012).

In addition, regional and field research centers funded by the federal government such as the Centers for Disease Control, U.S. Geological Survey, the Department of the Interior , and the Barrow Arctic Research Center (which also has research facilities in the village of Atqasuk and supports research in Chukotka, Russian Siberia) require broadband connectivity to transmit field data, access remote computing facilities, and collaborate with other researchers. Also, broadband in the form of videoconferencing can enable indigenous experts in the North to participate in research, for example, to identify and explain artifacts held in distant museums and research collections (Garrick, 2008).

Healthcare

Alaska has been a pioneer in rural telemedicine, dating from experiments with NASA satellites in the 1970s. Previously, village health aides had relied on two-way radio for a daily "radio call" with doctors at regional hospitals and to reach hospitals in an emergency. The radio system was notoriously unreliable in much of remote Alaska, and in some cases, radios were only in teachers' homes and not at the clinic. The experiments on NASA satellites showed that reliable

[3] Derived from data available at www.usac.org

voice communication between health aides and doctors could improve diagnosis and treatment of village patients, and generally resulted in fewer patient evacuations (Hudson and Parker, 1973). These experiments were followed by installation of commercial satellite earth stations that brought telephone service to every permanent community of at least 25 people and a dedicated voice network linking village clinics to regional hospitals. This investment required the collaboration of the State government, the Public Health Service, and the private sector.

The AFHCAN (Alaska Federal Health Care Access Network) was established in the 1990s to provide greater support to village health aides by adding a terminal in each clinic with a computer and peripheral equipment such as an electronic otoscope, EKG monitor, and digital camera. The system was originally designed to operate over low bandwidth, but upgrades now include videoconferencing for training and patient consultations, and current implementation of an electronic health records (EHR) system. The increased bandwidth has been possible largely due to FCC Universal Service Fund (USF) subsidies for rural health care, which pay the difference between the costs of connectivity in rural areas and Anchorage. In 2011, Alaska received more than $44.7 million, more than 53 percent of the total amount allocated by the fund.[4]

Today, Alaska remains a global leader in telemedicine, with 248 sites and more than 33,000 cases per year. Research by ANTHC has also documented travel savings of over $2.85 million dollars for Medicaid from 2003 to 2009, so that for every $1 spent by Medicaid on reimbursement, $10.54 was saved on travel costs. (Ferguson and Kokesh, 2011)

In a study of electronic health record (HER) adoption throughout the Indian Health Service, Sequist et al. (2007) found that, of responding physicians, two-thirds felt that the HER implementation process was positive. The majority (87%) of clinicians felt that information technology could potentially improve quality of care in rural and underserved settings through the use of tools such as online information sources, telemedicine programs, and electronic health records.

However, Bahensky (2008) notes that financial barriers and a large number of health information technology (HIT) vendors offering different solutions present significant risks to rural health care providers. “Although evidence in the literature has demonstrated benefits of adopting HIT such as EMRs (electronic medical records), important technical, policy, organizational, and financial barriers still exist that prevent the implementation of these systems in rural settings” .

E-Commerce, Rural Business and Natural Resources

E-Commerce:

In its comments to NTIA in 2009, the State of Alaska pointed out how broadband could facilitate e-commerce and other e-service applications in rural Alaska: “The availability of the internet through broadband access offers the best method for advertising goods and services in Alaska’s rural communities. Enterprises such as ecotourism businesses and Native handicrafts are just two examples of how broadband can aid economic development. Internet access also offers a means to purchase supplies and equipment which can reduce the cost of doing business.

[4] Derived from data available at www.usac.org

Additionally, broadband access encourages businesses to take advantage of the full range of internet services such as federal tax preparation and reporting, internet banking, grant and loan applications, participation in training opportunities, networking through trade associations, research and general communications." (State of Alaska, 2009) A study for the USDA Alaska Service Center added: "Broadband, in combination with renewable energy development, could also open the door for job creation in placement of server farms and electronic document storage." (USDA, 2010)

It should be noted that most Alaska businesses are very small. More than 60 percent have 4 or fewer employees, and a total of 89 percent of businesses have fewer than 20 employees. However, half of Alaska jobs are in firms with 100 or more employees.[5]

A study by Connect Alaska (2011) cites examples of how Alaska businesses use technology more intensively or differently from businesses elsewhere in the U.S. For example:

- Among Internet-connected businesses in Alaska, almost three-fourths (72% or 12,000 businesses) research or book business travel arrangements online, significantly higher than the average among Connected Nation states/territories.
- Seven out of ten rural Alaskan businesses (70%) that use the Internet track and control their shipments online, which is vital for remote businesses; this is significantly higher than the average among rural businesses in Connected Nation states/territories.
- Nearly three out of five (57%) Internet-connected Alaska businesses in the High Tech sector provide online training; this is significantly higher than the average within the High Tech sector across Connected Nation states/territories.

Connect Alaska also found that across Alaska, 23% of businesses (approximately 5,000) allow employees to telework. This is similar to the percent of businesses that allow teleworking in other regions where Connected Nation operates.

However, there may be barriers to adoption of broadband by rural businesses. Pociask (2005) finds both demand-side and supply-side barriers. Demand may be low not only because of small populations but also where rural residents are somewhat older, less wealthy and less educated than urban households – factors that appear to correlate with less online and broadband usage. He also identifies supply-side reasons that may explain why some rural small businesses use broadband services less than urban small businesses, generally where broadband prices are higher than in urban areas. Other studies examine barriers to e-commerce adoption among small businesses. For example, Darch (2002) found that lack of knowledge and technological skills plus structural issues were barriers to engagement in e-commerce by small- to medium-enterprises (SMEs) within the food industry in Australia.

Natural Resources:

Alaska's economy is heavily dependent on natural resources. The petroleum industry has broadband capacity linking its facilities in Prudhoe Bay with Valdez and Anchorage, and with operations and management support elsewhere in the U.S. or overseas. Exploitation of additional petroleum reserves around the state will require communications for operations, logistics, and

[5] Alaska Department of Labor and Workforce Development, *Alaska Economic Trends*, vol. 32, no. 9, September 2012.

environmental monitoring. Similarly, the mining industry will need reliable communications to link its mine explorations and field operations with management and support in urban centers in Alaska and elsewhere in the U.S., while fisheries companies require communications from offshore to onshore canneries and supply bases in Alaska, and to management and support facilities typically located in Washington State.

Broadband may also be used to deliver onsite training for employees of Alaska's natural resources industries. For example, Cardinali (2010) examines strategies to compete in petroleum industry labor provisioning and skills training, with an analysis of solutions "to better produce, assemble, distribute and share open knowledge resources across open and interoperable networks while personalizing them for different skill gaps, personal media and location of use."

Concerning mining, Shideler et al. (2007) found in Kentucky that broadband deployment had a positive and significant impact on the mining industry. He considers that this result is "not surprising, because the industry relies heavily on broadband technology for many of its production and communication processes, including the transmission of market prices on which production decisions are made." However, the sample size was too small for generalization.

Much of the research on ICTs and fisheries concerns use of cellphones to enable fishermen in developing regions to find out competitive prices for their catch, just as small farmers have been able to get information on prices from urban markets for their crops, rather than relying on local middlemen. (See Waverman, et al., 2005.) Availability of GPS is also useful for navigation. See, for example, Omar (2011). Managers of commercial fishing and seafood processors interviewed for the TERRA survey said that broadband would be useful for management and back office support, as well as for personal use by seasonal employees. These applications would also likely apply to other major natural resource industries such as mining, oil and gas, and forestry.

Sustainability:

Dodd (2007) states that broadband contributes to environmental sustainability on many different levels:

> It increases access to information, improves international accountability, provides a platform for lobby groups and concerned individuals to raise awareness and creates new markets for sustainable products. Broadband will be central to international activity to reduce carbon emissions, manage the risk that changing environmental conditions will bring and to the growth of the clean technology industry. The application of broadband to these purposes is the true value of the infrastructure. The key to ensuring a sustainable society will be dependent on ICT developments adhering to environmental sustainability principles and committing to a 'life cycle' management approach.

Saunders (2007) notes that access to satellite imaging and geo-positioning data accessible through broadband connections can contribute to benefits including improved water management, crop assessment, land clearing, soil erosion, salt contamination and pollution.

Broadband is also likely to be an important component of strategies to develop ecotourism and other ecosystem services through websites and online support for reservations and logistics.

E-Government

The terms e-government and e-governance are often used interchangeably, but e-governance has a somewhat wider meaning. Dawes (2008) states that e-governance "comprises the use of information and communication technologies (ICTs) to support public services, government administration, democratic processes, and relationships among citizens, civil society, the private sector, and the state." She examines five interrelated objectives: a policy framework, enhanced public services, high-quality and cost-effective government operations, citizen engagement in democratic processes, and administrative and institutional reform. Her assessment of e-governance in U.S. states and local governments concludes that the greatest investment and progress have been made in enhanced public services and improved government operations.

At the state level, Thompson and Garbacz (2008) find that increasing the broadband network significantly reduces inefficiency in state economies. At the municipal level, Schwester (2009) states that e-government adoption is a function of financial, technical, and human resources. Holding all other factors constant, he found that municipalities with higher operating budgets, more full-time IT staff, and technical hardware are more likely to have a comprehensive e-government platform.

The Scandinavian countries have perhaps the longest experience with e-government. Flak et al. (2005) explored the factors that shape the development of municipal e-government in Norway. Their research suggests that the dominant stakeholder in development is the bureaucratic administration (rather than citizens or politicians). Administrators had a strong focus on internal efficiency and cost reduction; the majority of respondents reported cost reduction as the major driver behind e-government development. However, the researchers also identified a need for a more citizen-centric approach emphasizing the need for improving access and service quality for citizens.

In municipal e-government in Sweden, Grunden (2009) found that management also increased its focus on efficiency. However, e-government demanded new competencies of both employees and clients. She concludes that "internal and external digital divides are social consequences of the implementation of e-services."

Landsbergen (2010) addresses potential roles of social media in e-governance. He identifies several mechanisms through which social media may improve governance, and postulates that "social media increases social and digital inclusion and thereby political inclusion. It also supports the identification of new leaders and leading organizations." He concludes that "a better way to think about social media is that it merely provides a small window of opportunity, which for a short period of time, allows government to comprehensively reexamine how it does things, and thereby, provides the opportunity to change policies and procedures in a way that improves government."

Public Safety and Disaster Communications

Connectivity can be vitally important for public safety and disaster communications. Experiences with manmade and natural disasters in the U.S. ranging from terrorist attacks to

floods, oil spills, and forest fires have demonstrated the need for telecommunications networks that are robust and interconnected. Thus, research on broadband connectivity and public safety primarily concerns technical issues such as interconnection of various dedicated networks and technological innovations, primarily in wireless that could augment existing networks. See, for example, Peha (2006) and Hallahan and Peha (2010).

An example of adaptations for disaster communications that could be useful in Alaska is dual use of technology. "During peaceful times, dual-use technology, such as a mobile phone, operates as an everyday personal communications device, but during an emergency it transforms into an information sensor and disseminator. This overcomes aversion to using different communications equipment during a crisis and eliminates the time lag caused by government agencies collecting, processing, and distributing crisis-related data." (Underwood, 2010)

The California Institute for Telecommunications and Information Technology (Calit2) has developed a peer-to-peer incident notification system that allows people to collect and relay information about events, such as wildfires and traffic accidents, to first responders and the general public using mobile phones. "The notification system is available in California's major cities and is based on speech recognition, allowing commuters to call in and report incidents, or call in and listen about events that could disrupt their travel…. Conversely, the system can notify all users of an incident via a voice call or text message." (Underwood, 2010) The developers note that unlike traditional disaster management systems that are inflexible and constrained by capacity, the peer-to-peer system can scale to deliver real-time information during a disaster, as there is no single channel of information and no single point of information control.

Conclusion

The research reviewed above indicates that it will be difficult to predict macrolevel impacts of universal access to broadband in Alaska. However, the studies do provide insights into how broadband may impact both the public and private sectors in the Alaska economy.

The bibliography contains many more studies that appear relevant for understanding the potential impact of broadband in Alaska development, and strategies that may be needed to optimize the benefits resulting from further investment in broadband infrastructure.

BROADBAND FOR ALASKA DEVELOPMENT: BIBLIOGRAPHY

1. Economic Analyses and International Organization Studies

Bauer, J. M., Gai, P., Kim, J., Muth, T. A. and Wildman, S. S. (2002) *Broadband: Benefits and Policy Challenges*. A Quello Center Report. Prepared for Merit Network, Inc., December 10, 2002. Accessible at: http://www.citeseerx.ist.psu.edu/viewdoc/download?doi=10.1.1.110.4171&rep=rep1&type=pdf

Connected Nation. (2008) *The Economic Impact of Stimulating Broadband Nationally*. Connected Nation, Inc. Accessible at: http://www.connectednation.org/sites/default/files/the_economic_impact_of_stimulating_broadband_nationally_-_full_version.pdf

Crandall, R., Lehr, W., and Litan, R. (2009) *The Effects of Broadband Deployment on Output and Employment: A Cross-Sectional Analysis of U.S. Data*. The Brookings Institution. http://www.brookings.edu/research/papers/2007/06/labor-crandall

Czernich, Nina, Falck, Oliver, Kretschmer, Tobias and Woessmann, Ludger, (2009) "Broadband Infrastructure and Economic Growth." CESifo Working Paper Series No. 2861, December 2009. Accessible at: http://ssrn.com/abstract=1516232

Duggal, V., Saltzman, C. and Klein, L. (2007) "Infrastructure and Productivity: An Extension to Private Infrastructure and IT Productivity." *Journal of Econometrics*, Volume 140, Issue 2, pp. 485-502. Accessible (with purchase) at: http://www.sciencedirect.com/science/article/pii/S030440760600145X

Draca, M., Sadun, R., and Van Reenen, J. (2006). "Productivity and ICT: A Review of the Evidence." CEP Discussion Paper 749, August 2006. Accessible at: http://cep.lse.ac.uk/pubs/download/dp0749.pdf

Economics and Statistics Administration, and National Telecommunications and Information Administration (NTIA). (2010) *Digital Nation: 21st Century America's Progress toward Universal Broadband Internet Access*. US Department of Commerce, February 2010. Accessible at: http://www.ntia.doc.gov/report/2010/digital-nation-21st-century-americas-progress-towards-universal-broadband-internet-acces

Federal Communications Commission. (2010) *Connecting America: The National Broadband Plan*. Washington, DC. Accessible at: http://www.broadband.gov/download-plan/

Hempell, T. (2005) "What's Spurious, What's Real? Measuring the Productivity Impacts of ICT at the Firm-level." *Empirical Economics*, Vol. 30, Issue 2, pp. 427-464. Accessible (with purchase) at: http://www.springerlink.com/content/j258711520077145/fulltext.pdf

Hoffler, F. (2007) "Costs and Benefits from Infrastructure Competition. Estimating Welfare Effects from Broadband Access Competition." *Telecommunications Policy*, Vol. 31, Issue 6, pp. 401-418. Accessible (with purchase) at: http://www.sciencedirect.com/science/article/pii/S0308596107000456

Holt, L. and Jamison, M. (2009) "Broadband and Contributions to Economic Growth: Lessons from the U.S. Experience." *Telecommunications Policy*, Vol. 33, Issues 10-11, pp. 575-581. Accessible at: http://www.itu.int/wsis/stocktaking/docs/activities/1287045684/sdarticle.pdf

International Telecommunication Union. (2012) *The State Of Broadband 2012: Achieving Digital Inclusion For All.* A Report of the U.N. Broadband Commission. Geneva: ITU. Accessible at: http://www.broadbandcommission.org/Documents/bb-annualreport2012.pdf

Jorgeson, D. (2001) "Information Technology and the American Economy." *American Economic Review*, Vol. 91, No. 1, pp. 1-33. Accessible at: http://bss.sfsu.edu/potepan/Paris/usit.pdf

Katz, R. (2012) *The Impact of Broadband on the Economy: Research to Date and Policy Issues*. An International Telecommunication Union (ITU) Broadband Report, April 2012. Accessible at: http://www.itu.int/ITU-D/treg/publications/bbreports.html

Katz, R. and Suter, S. (2009) "Estimating the Impact of the Broadband Stimulus Plan." Columbia Institute for Tele-information (CITI), Columbia Business School, working paper. Originally published February 2009; web publication July 2010. Accessible at: http://citi25.wordpress.com/raul-katz/articles-2009/2009-impact-of-broadband-stimulus/

Koutroumpis, P. (2009) "The Economic Impact of Broadband on Growth: A Simultaneous Approach." *Telecommunications Policy*, Vol. 33, Issue 9, pp. 471-475. Accessible (with purchase) at: http://www.sciencedirect.com/science/article/pii/S0308596109000767

Lehr, W. and Lichtenberg, F. (1999) "Information Technology and Its Impact on Productivity: Firm-level Evidence from Government and Private Data Sources, 1977-1993." *Canadian Journal of Economics*, Vol. 32, Issue 2, Special Issue on Service Sector Productivity and the Productivity Paradox, April 1999, pp. 335-362. Accessible at: http://www.csls.ca/journals/sisspp/v32n2_05.pdf.

Lehr, W., Osorio, C., Gillett, S., and Sirbu, M. (2005) "Measuring Broadband's Economic Impact," *Broadband Properties Magazine*, Vol. 25, No. 12, December 2005, pp. 12-25. Accessible at: http://www.broadbandproperties.com/2005issues/dec05issues/Measuring%20Broadband%20Eco%20Impact,%20Lehr,%20Gilett,%20Sirbu.pdf

Lehr, W., and Smith-Grieco, T., (2009). *Measurement and Assessment of Broadband Availability*. A Report prepared for John Adams Innovation Institute at the Massachusetts Technology Collaborative. Accessible at: http://people.csail.mit.edu/wlehr/Lehr-Papers_files/LehrJan09%20bb%20availability.pdf

Oliner, S. and Sichel, D. (2000) "The Resurgence of Growth in the Late 1990's: Is Information Technology the Story?" *Journal of Economic Perspectives*, Vol. 14, No. 4, Fall 2000, pp. 3-22. Accessible at: http://www.aeaweb.org/articles.php?doi=10.1257/jep.14.4.3

Organization for Economic Co-operation and Development (OECD) (2011) *OECD Communications Outlook 2011*. July 2011. Paris: OECD. Accessible (with purchase) at: http://www.oecd.org/sti/broadbandandtelecom/oecdcommunicationsoutlook2011.htm

Organization for Economic Co-operation and Development (OECD) (2011) *OECD Guide to Measuring the Information Society 2011*. August 2011. Paris: OECD. Accessible (with purchase) at: www.oecd.org/sti/measuring-infoeconomy/guide

Roeller, L. and Waverman, L. (2001) "Telecommunications Infrastructure and Economic Development: A Simultaneous Approach." *The American Economic Review*, Vol. 91, Issue 4, pp. 909-923. Accessible (with log in) at: http://www.jstor.org/stable/pdfplus/2677818.pdf?acceptTC=true

Thompson, H. G., and Garbacz, C. (2008). "Broadband impacts on state GDP: Direct and Indirect Impacts." Paper presented at the 17th Biennial Conference on International Telecommunications Society (ITS), held June 24th - 27th 2008. Accessible at: http://www.canavents.com/its2008/abstracts/62.pdf

Wallsten, S. (2009). *Measuring the Effectiveness of the Broadband Stimulus Plan. The Economists' Voice*, Vol. 6, Issue 6, May 2009, pp. 1-3. Accessible at: http://www.degruyter.com/view/j/ev.2009.6.6/ev.2009.6.6.1570/ev.2009.6.6.1570.xml?format=INT

2. Rural and Regional Development

Chan, Y., Hassanein, H., Ivus, O., Middleton, C., Murray, E., Taha, A.-E., Wood, K., Benecki, L., Dixon, J., Khodakarami, F., Teboul, J., and Wasteneys, C. (2011) *Broadband Strategic Research and Impact Analysis: Development of a Partnership and Evaluation Framework for Assessing the Social and Economic Impacts of Provincial Broadband Investments*. Report prepared for the Ontario Ministry of Government Services. Kingston, Ontario: Monieson Centre, Queen's School of Business. http://business.queensu.ca/centres/monieson/research/docs/Final%20report%20Broadband

Collins, J., & Wellman, B. (2010). "Small Town in the Internet Society: Chapleau Is No Longer an Island." *The American Behavioral Scientist*, Vol. 53, Issue 9, pp. 1344-1366. Accessible at: http://homes.chass.utoronto.ca/~wellman/publications/chapleau/Small_Town_in_Internet_Society.pdf

Dabson, B. and Keller, J. (2008). *Rural Broadband*. A Rural Policy Research Institute (RUPRI) Policy Brief, December 8, 2008. Accessible at: http://www.rupri.org/Forms/RuralBroadbandFinal.pdf

Ford, G.S., and Koutsky, T. (2005). "Broadband and Economic Development: A Municipal Case Study from Florida." *Review of Urban and Regional Development Studies*, Vol. 17, Issue 3, pp. 216-229. Accessible at: http://papers.ssrn.com/sol3/papers.cfm?abstract_id=925973

Galloway, L. (2007). "Can Broadband Access Rescue the Rural Economy?" *Journal of Small Business and Enterprise Development*, Vol. 14, Issue 4, pp. 641-653. Accessible (with purchase) at: http://www.emeraldinsight.com/journals.htm?articleid=1636472

Henderson, J. (2002). "Building the Rural Economy through High-Growth Entrepreneurs." *Economic Review – Federal Reserve Bank of Kansas City*, Vol. 87, No. 3, 3rd Quarter 2002, pp. 45-70. Accessible at: http://www.kc.frb.org/Publicat/econrev/Pdf/3q02hend.pdf

Hudson, H. E. (2006). *From Rural Village to Global Village: Telecommunications for Development in the Information Age*. New York: Routledge.

Hudson, Heather E. (2011). "Rural Broadband: Strategies and Lessons from North America." *Intermedia*, Vol. 39, Issue 2, May 2011, pp. 12-19. Accessible at: http://www.iser.uaa.alaska.edu/Publications/IntermediaVol39No2NorthAmericabroadband.pdf

Irshad, H. (2009). "Broadband: An Effective Tool for Rural Development." Rural Development Division, Government of Alberta. Accessible at: http://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/csi12871

Kandilov, I. and Renkow, M. (2010). "Infrastructure Investment and Rural Economic Development: and Evaluation of USDA's Broadband Loan Program." *Growth and Change*, Vol. 41, No. 2, June 2010, pp. 165-191. Accessible (with log in) at: http://onlinelibrary.wiley.com/doi/10.1111/j.1468-2257.2010.00524.x/abstract; an alternative version, originally presented at the North Carolina State University's (NCSU's) Agriculture Economics Workshop (Fall 2009), is accessible at http://www.ag-econ.ncsu.edu/fall09_schedule.html

Kolko, J. (2010). *Does Broadband Boost Local Economic Development?* Public Policy Institute of California. Accessible at: http://www.ppic.org/main/publication.asp?i=866

LaRose, R., Strover, S., Gregg, J. L., Straubhaar, J. (2011). "The Impact of Rural Broadband Development: Lessons from a Natural Field experiment." *Government Information Quarterly***,** Vol. 28, Issue 1, January 2011, pp. 91-100. Accessible at: http://www.sciencedirect.com/science/article/pii/S0740624X10001036

Shideler, D., Badasyan, N., and Taylor, L. (2007) "The Economic Impact of Broadband Deployment in Kentucky." *The Federal Reserve Bank of St. Louis: Regional Economic Development*, Vol. 3, No. 2, pp. 88-118. Accessible at: http://research.stlouisfed.org/publications/red/2007/02/Shideler.pdf

Stenberg, P, Morehart, M., Vogel, S., Cromartie, J., Breneman, V., and Brown, D. (2009) *Broadband Internet's Value for Rural America.* US Department of Agriculture, Economic Research Service, Economic Report Number 78, August 2009, 70 pp. Accessible at: http://www.ers.usda.gov/publications/err-economic-research-report/err78.aspx

Taylor Warwick Consulting Ltd. (2010). *Accelerating Broadband Enablement in Rural Alberta*. Alberta Economic Development Authority, Sustainable and Regional Development Committee, April 2010. Accessible at: https://aeda.alberta.ca/reportsandstudies/aedastudies/Documents/FINAL%20AEDA%20BROADBAND%20REPORT.pdf

Van Gaasbeck, K. A. (2008). "A Rising Tide: Measuring the Economic Effects of Broadband Use across California." *The Social Science Journal*, Vol. 45, Issue 4, pp. 691-699. Accessible at: http://www.sciencedirect.com/science/article/pii/S0362331908000955

Whitacre, B. (2010). "The Diffusion of Internet Technologies to Rural Communities: A Portrait of Broadband Supply and Demand." *The American Behavioral Scientist*, Vol. 53, Issue 9, May 2010, pp. 1283-1303. Accessible at: http://abs.sagepub.com/content/53/9/1283

Zachary P. Neal, (2010). "From Central Places to Network Bases: A Transition in the U.S. Urban Hierarchy, 1900–2000," *City & Community*, Vol. 10, Issue 1, first published online August 2010, pp. 49-75. Accessible at: http://onlinelibrary.wiley.com/doi/10.1111/j.1540-6040.2010.01340.x/abstract

3. Alaska and the North

Alexander, C. J., Adamson, A., Daborn, G., Houston, J., and Tootoo, V. (2009). "Inuit Cyberspace: The Struggle for Access for Inuit Qaujimajatuqangit." *Journal of Canadian Studies*, Vol. 43, No. 2, pp. 220-249. Accessible at: http://muse.jhu.edu/journals/journal_of_canadian_studies/v043/43.2.alexander.pdf

Beck, R., Eisner, W., Hinkel, K., Pesanti, H., Ellis, B., Beiswenger, E., Parker, W., Treadwell, M., Smith, S., Krogh, L., Hansen, K. G., and Peskov, V. (2005). "Nutarniq: Uniting the Arctic Community with a Wireless Arctic Network for Circumpolar Communications." *Polar Geography*, Vol. 29, Issue 1, pp. 43-78. Accessible (with purchase) at: http://www.tandfonline.com/doi/abs/10.1080/789610165

Bjarnason, T. Gudmundsson, B. and Olafsson, K. (2011). "Towards a Digital Adolescent Society? The Social Structure of the Icelandic Adolescent Blogosphere." *New Media & Society*, Vol. 13, No. 4, pp. 645-662. Accessible (with log in) at: http://nms.sagepub.com/content/13/4/645

Canadian Radio-Television and Telecommunications Commission (CRTC). (2011). *Telecom Regulatory Policy CRTC 2011-291: Obligation to Serve and Other Matters.* Ottawa: 3 May 2011. Available at: http://www.crtc.gc.ca/eng/archive/2011/2011-291.htm

Connect Alaska. (2011). "Broadband and Business: Leveraging Technology in Alaska to Stimulate Economic Growth." An Alaska Business White Paper. Washington, DC: Connected Nation. Accessible at: http://www.connectak.org/_documents/AK_BizWhitePaper_FINAL.pdf

Dinero, S. C., Mariotz, E. and Bhagat, P. (2007) "Bridging the Technology Gap: Building a Development Model for Rural Alaska." *Journal of Cultural Geography*, Vol. 24, Issue 2. Accessible (with log in) at: http://www.tandfonline.com/doi/abs/10.1080/08873630709478211#preview

Fiser, A. and Clement, A. (2009) "K-Net and Canadian Aboriginal Communities." IEEE Technology and Society Magazine, Vol. 28, Issue 2, Summer 2009, pp. 23-33. Accessible (with log in) at: http://ieeexplore.ieee.org/xpls/abs_all.jsp?arnumber=5072379&tag=1

Fiser, A., Clement, A. and Walmark, B. (2006) "The K-Net Development Process: A Model for First Nations Broadband Community Networks." Canadian Research Alliance for Community Innovation and Networking (CRACIN), Working Paper No. 2006-12. Accessible at: http://archive.iprp.ischool.utoronto.ca/cracin/publications/pdfs/WorkingPapers/CRACIN%20Working%20Paper%20No%2012.pdf

Garrick, R. "Elder examines Aboriginal Artifacts via Videoconference." Keewaytinook Okimakanak Research Institute (KORI) research article, first published online April 14, 2008. Accessible at: http://research.knet.ca/node/194

Gratton, M.-F. and O'Donnell, S. (2011) "Communication Technologies for Focus Groups with Remote Communities: A Case Study of Research with First Nations in Canada." *Qualitative Research*, Vol. 11, No. 2, April 2011, pp. 159-175. Accessible (with log in) at: http://qrj.sagepub.com/content/11/2/159.abstract

GwaiiTel (2006). "GwaiiTel Launches High Speed Internet Services in Haida Gwaii." November 28, 2006. Accessible at: http://www.gwaiitel.com/newscontd.html

Hudson, H. E. (2011) "Digital Diversity: Broadband and Indigenous Populations in Alaska" *Journal of Information Policy,* Vol. 1, pp. 378-393. Accessible at: jip.vmhost.psu.edu/ojs/index.php/jip/article/download/42/37; an alternative version is accessible at: http://www.iser.uaa.alaska.edu/Publications/DigitalDiversityAlaskaHudson.pdf

Hudson, H. E. (2011) "Connectivity across the Arctic: A Comparative Analysis of Broadband Access in Alaska, Northern Canada, and Greenland." Paper presented at the International Congress of Arctic Social Sciences, Akureyri, Iceland, June 22nd – 26th 2011. Accessible at: www.iser.uaa.alaska.edu

Hudson, H. E., and Pittman, T. S. (1999) "From Northern Village to Global Village: Rural Communications in Alaska." *Pacific Telecommunications Review*, Vol. 21, No. 2.

Imaituk Inc. (2011) *A Matter of Survival: Arctic Communications Infrastructure in the21st Century*. Arctic Communications Infrastructure Assessment (ACIA) Report. Prepared for the Northern Communications and Information Systems Working Group, April 30, 2011. Canadian Northern Economic Development Agency (CanNor). Accessible at: www.aciareport.ca

Institute of Social and Economic Research. (2011). *The Evolution of Telecommunications in Alaska: From Bush Telephones to Broadband*. Symposium organized by the Institute of Social and Economic Research (ISER), University of Alaska Anchorage, June 2011. PowerPoint presentation slides and a video of the proceedings. Accessible at: http://www.iser.uaa.alaska.edu/Projects/akbroadbandproj/aktelesymposium.php

K-Net. "Keewaytinook Okimakanak." www.knet.ca

McDowell Group. (2009). *Alaska Geographic Differential Study*. Prepared for the Alaska State Department of Administration. Accessible at: http://doa.alaska.gov/dop/gds/home.html

McKeon, L., and Ganley, M. (2011) "The North's Digital Leaders." *Up Here Business*, 076 February 2011. Accessible at: http://www.upherebusiness.ca/node/491

McMahon, R. (2011). "The Institutional Development of Indigenous Broadband Infrastructure in Canada and the United States: Two Paths to 'Digital Self-Determination.'" *Canadian Journal of Communication*. Vol. 36, Issue 1, January 2011, pp. 115-140. Accessible at: http://www.cjc-online.ca/index.php/journal/article/view/2372/2227

Mignone, J. and Henley, H. (2009). "Impact of Information and Communication Technology on Social Capital in Aboriginal Communities in Canada." *Journal of Information, Information Technology, and Organizations*, Vol. 4, pp. 127-145. Accessible at: http://umanitoba.ca/faculties/human_ecology/departments/fss/media/5.pdf

Nunavut Broadband Development Corporation (NBDC). (2012). "Nunavut Schools to Benefit from Improved Internet Access." News release, first published online February 14, 2012. Accessible at: http://www.nunavut-broadband.ca/PDF/2012_Feb14_NR_Classroom_Connect_ENG.pdf

O'Donnell, S., Perley, S., Walmark, B., Burton, K., Beaton, B., and Sark, A. (2007). *Community-based broadband organizations and video communications for remote and rural First Nations in Canada.* Proceedings of the Community Informatics Research Network (CIRN) Conference, Prato, Italy, November 2007. Accessible at: http://www.susanodonnell.info/downloads/2007-VideoCom-CIRN.pdf

Qiniq. 2012. "Qiniq Network Gets Boost from Broadband Canada Program." Available at: http://www.qiniq.com/node/121

Salter Global Consulting Inc. "Nunavut Fibre Optic Feasibility Study." (2012) Prepared for the Nunavut Broadband Development Corporation (NBDC). Accessible at: http://www.nunavut-broadband.ca/fiberOpticReport.html

Southwest Alaska Municipal Conference (SWAMC). (2010) Southwest *Alaska Broadband Strategy: "Planning for Opportunity."* Draft published October 6th, 2010. Accessible at: http://www.swamc.org/files/Southwest%20Alaska%20Broadband%20Strategy_DRAFT.pdf

U.S. Department of Agriculture. (2010). *Alaska Forum on Jobs and Economic Development*.: Final Report. Palmer, Alaska: USDA Service Center. Accessible at: http://www.fsa.usda.gov/Internet/FSA_File/usda_rept_final_02152010.pdf

Warf, B. (2011) "Contours, Contrasts, and Contradictions of the Arctic Internet." *Polar Geography*, Vol. 34, Issue 3, September 2011, pp. 193-208. Accessible (with log in) at: http://www.tandfonline.com/doi/abs/10.1080/1088937X.2011.589012

Windeyer, C. "Nunavut Internet Users lag far behind Canada." *Nunatsiaq Online* news update, first published online November 18, 2010. Accessible at: http://www.nunatsiaqonline.ca/stories/article/87678_nunavut_internet_users_lag_far_behind_canada/

4. Adoption

Baller, J., and Lide, C. (2008) *Capturing the Promise of Broadband in NC and America*. Ballard Herbst Law Group. Accessible at: http://www.baller.com/pdfs/BallerHerbst_e-NC_White_Paper.pdf

Beard, T. R., Ford, G. S., Spiwak, L. J. and Stern, M. L. (2010) "The Broadband Adoption Index: Improving Measurements and Comparisons of Broadband Deployment and Adoption." *Federal Communications Law Journal*, Vol. 62, Issue 2, March 2010, pp. 343-402. Accessible at: http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1626363

Benkler, Y. (2010). *Next Generation Connectivity: A Review of Broadband Internet Transitions and Policy from around the World*. Berkman Centre for Internet and Society, Harvard University. Accessible at: http://cyber.law.harvard.edu/pubrelease/broadband/

California Broadband Taskforce. (2008) *Final Report*. California Technology Agency. Accessible at: http://www.cio.ca.gov/broadband/taskforcereport/default.asp

Cooper, M. (2010). *The challenge of digital exclusion in America: A review of the social science literature and its implications for the U.S. National Broadband Plan*. Consumer Federation of America. Accessible at: http://apps.fcc.gov/ecfs/document/view?id=7020384062

CostQuest Associates, Inc. (2010) *Broadband Assessment Model*. Prepared as part of the Federal Communications Commission's National Broadband Plan. Last updated March 2010. Accessible at: http://download.broadband.gov/plan/fcc-omnibus-broadband-initiative-%28obi%29-working-reports-series-technical-paper-broadband-assessment-model.pdf

Dailey, D., Bryne, A., Powell, A., Karaganis J., and Chung, J. (2010) *Broadband Adoption in Low-Income Communities.* Social Science Research Council. Report commissioned by the Federal Communications Commission as part of the National Broadband Plan. Accessible at: http://www.ssrc.org/publications/view/1EB76F62-C720-DF11-9D32-001CC477EC70/

Daly, A. (2005). "Bridging the Digital Divide: The Role of Community Online Access Centres in Indigenous Communities." The Centre for Aboriginal Economic Policy Research (CAEPR), Australian National University College of Arts and Social Sciences, Discussion Paper 273. Accessible at: http://caepr.anu.edu.au/Publications/DP/2005DP273.php

Economics and Statistics Administration, and National Telecommunications and Information Administration. (2010) *Exploring the Digital Nation: Home Broadband Internet Adoption in the United States.* US Department of Commerce, November 2010. Accessible at: http://www.ntia.doc.gov/report/2010/exploring-digital-nation-home-broadband-internet-adoption-united-states

Economics and Statistics Administration, and National Telecommunications and Information Administration. (2011) *Exploring the Digital Nation: Computer and Internet Use at Home*. US Department of Commerce, November 2011. Accessible at: http://www.ntia.doc.gov/report/2011/exploring-digital-nation-computer-and-internet-use-home

e-NC Authority. (2009) *Capturing the Promise: A 10-Year Action Plan using Broadband Internet to Increase North Carolina's Competitiveness and Sustainability in the Global Economy*. North Carolina Department of Commerce. Accessible at: http://ncbroadband.gov/system/resources/BAhbBlsHOgZmSSJJMjAxMS8wMy8xOC8xMF8xM181M18yNDlfY2FwdHVyaW5nX3RoZV9wcm9taXNlXzEweXJfaW50ZXJuZXRfcGxhbi5wZGYGOgZFVA/capturing_the_promise_10yr_internet_plan.pdf

Federal Communications Commission. (2009) *National Broadband Plan Workshop: Diversity and Civil Rights Issues in Broadband Deployment and Adoption*. Accessible at: http://www.broadband.gov/ws_diversity.html

Forman, C. (2005). "The Corporate Digital Divide: Determinants of Internet Adoption." *Management Science*, Vol. 51, Issue 4, April 2005, pp. 641-654. Accessible (with log in) at: http://www.jstor.org/stable/20110358

Gilroy, A. A. (2011) *Access to Broadband Networks: The Net Neutrality Debate*. Congressional Research Service. April 25, 2011. Accessible at: https://opencrs.com/document/R40616/

Goldstein, M. (2006) *Challenges to Assessing and Improving Telecommunications for Native Americans on Tribal Lands*. Testimony given before the U.S. Senate: Committee on Commerce, Science, and Transportation. United States Government Accountability Office, March 2006. Accessible at: http://www.gao.gov/products/GAO-06-513T.

Greenstein, S. and Prince, J. (2008). "The Diffusion of the Internet and the Geography of the Digital Divide in the United States." In *The Oxford Handbook of Information and Communication Technologies*, Mansell, R., Avgerou, C., Quah, D., and Silverstone, R. eds). New York: Oxford University Press USA. Accessible at: http://www.kellogg.northwestern.edu/faculty/greenstein/images/htm/Research/chapters/Internet%20geography2.pdf;

Horrigan, J. B. (2009) *Broadband Adoption and Use in America*. The Federal Communications Commission Omnibus Broadband Initiative (OBI) Working Paper Series No. 1. Accessible at: http://online.wsj.com/public/resources/documents/FCCSurvey.pdf

International Telecommunication Union (ITU). (2007) *Digital Opportunity Index*. Geneva: ITU. Accessible at: http://www.itu.int/ITU-D/ict/doi/index.html

LaRose, R., Gregg, J.L., Strover, S., Straubhaar, J., and Carpenter, S. (2007). "Closing the Rural Broadband Gap: Promoting Adoption of the Internet in Rural America." *Telecommunications Policy*, Vol. 31, Issue 6-7, July 2007, pp. 359-373. Accessible (with log in) at: http://www.sciencedirect.com/science/article/pii/S0308596107000444

Minnesota Ultra High-Speed Broadband Taskforce. (2010) *Minnesota Ultra High-Speed Broadband Plan*. Minnesota Department of Commerce. Accessible at: http://www.ultra-high-speed-mn.org/CM/Custom/UHS%20Broadband%20Report_Full.pdf

Nafus, D. and Mainwaring, S. D. (2010) *Rural Broadband Expansion in the United States: Citizen Perception as a Social Process*. Paper presented at the Technology Policy Research Conference (TPRC), Washington, D.C., August 15th, 2010. Accessible at: http://ssrn.com/abstract=1989653

New York State Council for Universal Broadband. (2009) *Connecting New York to the World for Sustainable Adoption: New York State Universal Broadband Strategic Roadmap*. New York State CIO and New York State Office for Technology. Accessible at: http://www.cio.ny.gov/assets/documents/Final_Broadband_Strategy_June2009.pdf

Noriega, R., McGovern, C., Joshi, D. and Walker, J. (2011) *Late to the Party: How New Broadband Subscribers Compare to Early Adopters*. Paper presented at the Technology Policy Research Conference (TPRC), Arlington, VA, September 23rd – 25th, 2011. Connected Nation, Inc. Accessible at: http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1995130

Peha, J. M. (2008) *Bringing Broadband to Unserved Communities*. Washington, DC: Brookings Institution. Accessible at: http://www.itu.int/wsis/stocktaking/docs/activities/1287154309/Carnegie_Mellon_University.pdf

Smith, Aaron. (2010) *Home Broadband 2010*. Washington, DC: Pew Internet and American Life Project, Pew Research Center. Accessible at: http://www.pewinternet.org/Reports/2010/Home-Broadband-2010.aspx

Strategic Networks Group. (2011) *Regional Analysis Report*. North Carolina Department of Commerce. Accessible at: http://ncbroadband.gov/system/resources/BAhbBlsHOgZmSSI6MjAxMi8wNi8yNi8xM180Ml8xN18zMF9OQ19SZWdpb25hbF9BbmFseXNpc19GaW5hbC5wZGYGOgZFVA/NC%20Regional%20Analysis%20Final.pdf

State of Alaska, Office of Management and Budget. (2009) *Response to NTIA, USDA RUS Joint Request for Information*. April 9, 2009. Accessible at: www.ntia.doc.gov/legacy/broadbandgrants/comments/71B4.doc

Waverman, L. , Meschi, M., and Fuss, M. (2005) "The Impact of Telecoms on Economic Growth in Developing Countries." In *Africa: The Impact of Mobile Phones*. Vodafone Policy Paper Series, March, 2005. Accessible at: http://info.worldbank.org/etools/docs/library/152872/Vodafone%20Survey.pdf

Wood, L. E. (2008) "Rural broadband: The Provider Matters." *Telecommunications Policy*, Vol. 32, Issue 5, June 2008, pp. 326-339. Accessible (with log in) at: http://www.sciencedirect.com/science/article/pii/S0308596107000845

World Bank (2009). *Information and Communications for Development 2009: Extending Reach and Increasing Impact*. Washington, DC: World Bank. Accessible at: http://issuu.com/world.bank.publications/docs/9780821376058

World Bank (2012). *Information and Communications for Development 2012: Maximizing Mobile.* Washington, DC: World Bank. Accessible at: http://siteresources.worldbank.org/EXTINFORMATIONANDCOMMUNICATIONANDTECHNOLOGIES/Resources/IC4D-2012-Report.pdf

5. Sector Studies

Education, Research, and Libraries

Alaska State Commission on Research (SCoR). "To Build a Fire: A Plan for the Future of Science and Technology in Alaska." Draft Report, July 3, 2012.

Bernard, R. M., Abrami, P. C., Lou Y., et al. (2004) "How Does Distance Education Compare With Classroom Instruction? A Meta-Analysis of the Empirical Literature." *Review of Educational Research*, Vol. 74, No. 3, Fall 2004, pp. 379-439. Accessible (with log in) at: http://rer.sagepub.com/content/74/3/379

Bertot, J. C. (2009) "Public Access Technologies in Public Libraries: Effects and Implications." *Information Technology and Libraries*, Vol. 28, No. 2, June 2009, pp. 81-91. Accessible at: https://acrl.org/ala/mgrps/divs/lita/publications/ital/28/2/bertot.pdf

Bertot, J. C., McClure, C. R., and Jaeger, P. T. (2005) "The E-rate Program and Libraries and Library Consortia." *Information Technology and Libraries*, Vol. 24, No. 2, June 2005, pp. 57-67. Accessible at: https://acrl.org/ala/mgrps/divs/lita/publications/ital/24/2/jaeger.pdf

Bertot, J. C., McClure, C. R., and Jaeger, P. T. (2008) "The Impacts of Free Public Internet Access on Public Library Patrons and Communities." *The Library Quarterly*, Vol. 78, No. 3, July 2008, pp. 285-301. Accessible at: http://mcclure.ii.fsu.edu/publications/2008/The impacts of free public Internet access on public library patrons and communities.pdf

Greaves, T. W., Hayes, J., Wilson, L., Gielniak, M., and Peterson, E. L. (2012) *Revolutionizing Education through Technology: The Project RED Roadmap for Transformation*. Eugene, OR and Washington, DC: International Society for Technology in Education. Accessible at: http://www.projectred.org/images/books/ISTE_Book.pdf
Synopsis at: http://www.projectred.org/

Daniel, J., West, P., D'Antoni, S., and Uvalić-Trumbić, S. (2005). "ICTs in Education: Can Digital Dividend Replace Digital Divide?" Paper presented at the Witfor Conference, Gaborone, Botswana, September 1st, 2005. Accessible at: http://www.col.org/resources/speeches/2005presentations/Pages/2005-09-01a.aspx

Hahn, S. and Lehman, L. (2006) "The Half-Million-Square-Miles Campus: University of Alaska Fairbanks Off-Campus Library Services." *Journal of Library and Information Services in Distance Learning* Vol. 2, Issue 3. Accessible (with purchase) at: http://www.tandfonline.com/doi/abs/10.1300/J192v02n03_02

Hoffman, J., Bertot, J. C., and Davis D. M. (2012) "Libraries Connect Communities: Public Library Funding and Technology Access Study 2011-2012." Digital supplement of *American Libraries*, Summer 2012. Accessible at: http://viewer.zmags.com/publication/4673a369

Hudson, H. E. (2009) "The Future of the E-Rate: U.S. Universal Service Fund Support for Public Access and Social Services." In ... *and Communications for All: An Agenda for a New Administration*, A. Schejter (ed.). Lanham, MD: Lexington Books.

Mandel, L. H., Bishop, B. W., McClure, C. R., Bertot, J. C., and Jaeger, P. T. (2010) "Broadband for Public Libraries: Importance, Issues, and Research Needs." Government Information Quarterly, Vol. 27, Issue 3, July 2010, pp. 280–291. Accessible (with purchase) at: http://www.sciencedirect.com/science/article/pii/S0740624X10000250

Information Policy and Access Center (IPAC). (2012) *Public Libraries and Broadband: Issues Brief*. Part of the Public Library Funding and Technology Access Study, IPAC, University of Maryland, published online May 31, 2012. Accessible at: www.plinternetsurvey.org/sites/default/images/Briefs/BroadbandBrief2012May312012-1.pdf

Page, G. A., and Hill, M. (2008) "Information, Communication, and Educational Technologies in Rural Alaska." *New Directions for Adult and Continuing Education*, Vol. 2008, Issue 117, Spring 2008, pp. 59-70. Accessible (with log in) at: http://onlinelibrary.wiley.com/doi/10.1002/ace.286/abstract

Perraton, H. (2010) *Teacher Education: The Role of Open and Distance Learning*. Vancouver, BC: Commonwealth of Learning. Accessible at: www.col.org/resources/publications/Pages/detail.aspx?PID=333

Schafft, K. A., Alter, T. R., and Bridger, J. C. (2006). "Bringing the Community Along: A Case Study of a School District's Information Technology Rural Development Initiative." *Journal of Research in Rural Education*, Vol. 21, No. 8, July 17, 2006, pp. 1-10. Accessible at: http://www.jrre.psu.edu/articles/21-8.pdf

Visser, M. and Ball, M. A. (2010) "The Middle Mile: The Role of the Public Library in Ensuring Access to Broadband." *Information Technology and Libraries*, Vol. 29, No. 4, December 2010, pp. 187-194. Accessible at: https://acrl.org/ala/mgrps/divs/lita/publications/ital/29/4/visser.pdf

Healthcare:

Alaska Federal Health Care Access Network (AFHCAN). Alaska Native Tribal Health Consortium. See: www.afhcan.org

Bahensky, J. A., Jaana, M., and Ward, M. M. (2008) "Health Care Information Technology in Rural America: Electronic Medical Record Adoption Status in Meeting the National Agenda." *The Journal of Rural Health*, Vol. 24, Issue 2, Spring 2008, pp. 101-105. Accessible (with log in) at: http://onlinelibrary.wiley.com/doi/10.1111/j.1748-0361.2008.00145.x/abstract

Ferguson, S., and Kokesh, J. (2011) *What Works: Outcomes Data from AFHCAN and ANTHC Telehealth: An 8 Year Retrospective*. Alaska Native Tribal Health Consortium. PDF copy of PowerPoint presentation accessible at:

http://www.iser.uaa.alaska.edu/Projects/akbroadbandproj/telecomsymposium/FergusonAFHCAN%20-%20What%20Works.pdf

Ferguson, S., Kokesh, J., Patricoski, C., Hofstetter, P., and Hogge, N. (2009) *Impact of Store-and-Forward Telehealth in Alaska: A Seven Year Retrospective; Impact and Experiences from Seven Years of Utilization within the AFHCAN System*. Alaska Native Tribal Health Consortium. Accessible at: http://www.hss.state.ak.us/healthcommission/meetings/200908/pdf/AFHCAN_impact.pdf

Hovenga, E.J.S., Kidd, M.R., Garge, S., Hullin, C. and Cossio, L. (2010) *Health Informatics: An Overview*. Amsterdam, the Netherlands: IOS Press. Accessible (with purchase) at: http://www.booksonline.iospress.nl/Content/View.aspx?piid=16108.

Hudson, H. E. (2007) "Rural Telemedicine: Lessons from Alaska for Developing Regions." *Journal of eHealth Technology and Application,* Vol. 5, No. 3, September 2007, pp. 460-467. Accessible (with purchase) at: http://online.liebertpub.com/doi/abs/10.1089/tmj.2005.11.460?url_ver=Z39.88-2003&rfr_id=ori:rid:crossref.org&rfr_dat=cr_pub%3dpubmed

Hudson, H. E., and Parker, E. B. (1973) "Medical Communication in Alaska by Satellite." *New England Journal of Medicine*, Vol. 289, Issue 25, December 20, 1973, pp. 1351-1356. Accessible (with purchase) at: http://www.nejm.org/doi/full/10.1056/NEJM197312202892506

Jennett, P. ,Yeo, M., Scott, R., Hebert, M. and Teo, W. (2005) "Delivery of Rural and Remote Health Care via a Broadband Internet Protocol Network - Views of Potential Users." *Journal of Telemedicine and Telecare*, Vol. 11, No. 8, pp. 419-424. Accessible (with purchase) at: http://jtt.rsmjournals.com/content/11/8/419.short

Keselman, A., Logan, R., Smith, C. A., Leroy, G., and Zeng-Treitler, Q. (2008) "Developing Informatics Tools and Strategies for Consumer-centered Health Communication." *Journal of the American Medical Informatics Association, Vol.* 15, Issue 4, July-August 2008, pp. 473-483. Accessible at: http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2442255/

Mair, F., Peterkin, G., Laing, A., Ferguson, J., and Fraser, S. (2008) "Feasibility of a Telemedicine 'Booth' for supporting Remote Care in Scotland." *Journal of Telemedicine and Telecare*, Vol. 14, Issue 3, April 2008, pp. 127-129. Accessible (with purchase) at: http://jtt.rsmjournals.com/content/14/3/127.abstract

McNickle, Michelle. "5 ways Telemedicine can boost Care in Rural Communities." Health Care IT News, October 13, 2011. Available at: http://www.healthcareitnews.com/news/5-ways-telemedicine-can-boost-care-rural- communities

Neuberger, N. (2007). "Advancing Healthcare Through Broadband: Opening Up a World of Possibilities." A White Paper for the Internet Innovation Alliance. Accessible at: http://geiselmed.dartmouth.edu/nhtp/pdf/advancing_healthcare_broadband.pdf

Schwager, H.A. (2010) "A Home Telepsychiatry in Arizona and Alaska (USA)." *European Psychiatry*, Volume 25, Supplement 1, pg. 1700. Accessible (with purchase) at: http://www.sciencedirect.com/science/article/pii/S0924933810716795

Sequist, T. D., Cullen, T., Hays, H., Taualii, M. M., Simon, S. R., and Bates, D. W. (2007) "Implementation and Use of an Electronic Health Record within the Indian Health Service." *Journal of the American Medical Informatics Association*. Vol. 14, Issue 2, March–April 2007, pp. 191-197. Accessible at: http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2213460/?tool=pmcentrez&rendertype=abstract

Siedlecki, J. B. (2004) *Telehealth in Rural/Remote Yukon Communities: Five Case Studies*. Ph.D. Dissertation, Department of Community Health Sciences, University of Calgary. Accessible (with log in) at: http://search.proquest.com.proxy.consortiumlibrary.org/docview/305360568

Smith, A. C., Bensink, M., Armfield, N., Stillman, J., and Caffery, L. (2005) "Telemedicine and Rural Health Care Applications." *Journal of Postgraduate Medicine*, Vol. 51, Issue 4, pp. 286-293. Accessible at: http://www.jpgmonline.com/article.asp?issn=0022-3859;year=2005;volume=51;issue=4;spage=286;epage=293;aulast=Smith

Tracy, J., Rheuban, K., Waters, R. J., DeVany, M., and Whitten, P. (2008) "Critical Steps to Scaling Telehealth for National Reform." *Telemedicine and e-Health*, Vol. 14, Issue 9, November 2008, pp. 990-994. Accessible (with purchase) at: http://online.liebertpub.com/doi/abs/10.1089/tmj.2008.0125

Whitacre, B. (2011) "Estimating the Economic Impact of Telemedicine in a Rural Community." *Agricultural and Resource Economics Review*, Vol. 40, Issue 2, August 2011, pp. 172-183. Accessible at: http://ageconsearch.umn.edu/bitstream/117770/2/ARER%2040-2%20pp%20172-183%20Whitacre.pdf

Whitten, P., Mair, F., Haycox, A., May, T., and Hellmich, S. (2002) "Systematic Review of Cost Effectiveness Studies of Telemedicine Interventions." *British Medical Journal*, Vol. 324, Issue 7351, June 15, 2002, pp. 1434-1437. Accessible at: http://www.bmj.com/content/324/7351/1434.pdf%2Bhtml

Yellowlees, P., Burke, M. M., Marks, S. L., Hilty, D. M., and Shore, J. H. (2008) "Emergency Telepsychiatry." *Journal of Telemedicine and Telecare*, Vol. 14, No. 6, pp. 277-281. Accessible (with purchase) at: http://jtt.rsmjournals.com/content/14/6/277.abstract

E-Commerce, Rural Business, Natural Resources:

Bai, Y., and Liyanage, J. P. (2010). "Evaluating and Optimising Integrated Planning in Complex Production Assets: Learnings from Offshore Petroleum Industry." *International Journal of Decision Sciences, Risk and Management*, Vol. 2, No. 3-4/2010, pp. 252-275. Accessible (with purchase) at: http://www.inderscience.com/info/inarticle.php?artid=37486

Barkai, A. and Henninger, H. (2010). "The Introduction of Elog Technology to the Fishing Industry, a Case Study: Ground Fish Sector Project." Oceans 2010 conference, Sept 20-23, 2010. Accessible at: http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=5663993

Bharadwaj, P. N., and Soni, R. G. (2007). "E-Commerce Usage and Perception of E-Commerce Issues among Small Firms: Results and Implications from an Empirical Study." *Journal of Small Business Management*, Vol. 45, Issue 4, October 2007, pages 501-521. Accessible (with purchase) at: http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1008091&

Cardinali, F. (2010). "The PEARL Initiative: Producing, Sharing and Managing blended Online, Mobile and Instructor Led Learning Content within the Oil Industry." Paper presented at the SPE Annual Technical Conference and Exhibition, Florence, Italy, September 20th – 22nd, 2010. Accessible (with purchase) at: http://www.onepetro.org/mslib/servlet/onepetropreview?id=SPE-135588-MS

Darch, H., and Lucas, T. (2002). "Training as an e-Commerce Enabler." *Journal of Workplace Learning*, Vol. 14, Issue 4, pp. 148-155. Accessible (with purchase) at: http://www.emeraldinsight.com/journals.htm?articleid=882253

Dodd, T. 2007. "The Role of Broadband in the Quest for Environmental Sustainability." *Telecommunications Journal of Australia*, Vol. 57, No. 2/3, pp. 28.1 to 28.12. Accessible at: tja.org.au/index.php/tja/article/view/162/174

Kim, J. B. (2006) "Determinants of B2B Adoption in South Korean Fishery Wholesale Firms: An Exploratory Study." *Reviews in Fisheries Science*, Vol. 14, Issue 3, pp. 285-301. Accessible (with purchase) at: http://www.tandfonline.com/doi/abs/10.1080/10641260600816510#preview

Pociask, S. B. (2005) *Broadband Use by Rural Small Businesses*. Small Business Research Summary, No. 269, December 2005. U.S. Small Business Administration, Office of Advocacy. Accessible at: http://www.marketingtechie.com/articles/SmallBusiness%20-%20Dec20.pdf

Ruiz-Molina, M., Gil-Saura, I., and Moliner-Velazquez, B. (2010). "Information and Communication Technologies in Rural Hotels." *International Journal of Sustainable Economy*, Vol. 2, Issue 1, pp. 1-15. Accessible (with purchase) at: http://www.inderscience.com/offer.php?id=29938

Saunders, R. (2007) "Broadband and the Environment." *Telecommunications Journal of Australia*, Vol. 57, No. 2/3, pp. 27.1 to 27.12. Accessible at: http://tja.org.au/index.php/tja/article/view/161

Omar, S. Z., Abu Hassan, M., Azril, H., Shaffril, M., Bolong, J., and D'Silva, J. L. (2011) "Information and Communication Technology for Fisheries Industry Development in Malaysia." *African Journal of Agricultural Research*, Vol. 6, No. 17, September 5th, 2011, pp. 4166-4176. Accessible at: http://www.academicjournals.org/ajar/abstracts/abstracts/abstracts2011/5%20Sept/Omar%20et%20al.htm

E-Government:

Chatfield, A. T. (2009) "Public Service Reform through e‐Government: a Case Study of 'e‐Tax' in Japan." *The Electronic Journal of E-Government*, Vol. 7, Issue 2, April 2009, pp. 135-146. Accessible at: http://www.ejeg.com/issue/download.html?idArticle=168

Dawes, Sharon S. (2009) "Governance in the Digital Age: A Research and Action Framework for an Uncertain Future." Government Information Quarterly, Vol. 26, Issue 2, April 2009, pp. 257–264. Accessible (with purchase) at: http://www.sciencedirect.com/science/article/pii/S0740624X08001500

Dawes, S. S. (2008) "The Evolution and Continuing Challenges of E-Governance." Public Administration Review, Vol. 68, Issue Supplement s1, December 2008, pp. S86–S102. Accessible at: http://faculty.cbpp.uaa.alaska.edu/afgjp/PADM610/Evolution and continuing challenges of E-Governance.pdf

Evans, D. and Yen, D. C. (2006) "E-Government: Evolving Relationship of Citizens and Government, Domestic, and International Development." *Government Information Quarterly*, Vol. 23, Issue 2, pp. 207–235. Accessible (with purchase) at: http://www.sciencedirect.com/science/article/pii/S0740624X05000936

Flak, L., Olsen, D., and Wolcott, P. (2005) "Local e-Government in Norway." *Scandinavian Journal of Information Systems*, Vol. 17, Issue 2, pp. 41-84. Accessible at: http://unpan1.un.org/intradoc/groups/public/documents/UN-OTHER/UNPAN032095.pdf

Freitas, F., Candeias Jr., Z., and Stuckenschmidt, H. (2010) "A new Usage for Semantic Technologies for eGovernment: Checking Official Documents Consistency." *The Electronic Journal of E-Government*, Vol. 8, Issue 2, December 2010, pp. 120-133. Accessible at: http://www.ejeg.com/issue/download.html?idArticle=203

Garson, G. D. (2006) Public Information Technology and E-Governance: Managing the Virtual State. Raleigh, NC: Jones and Bartlett Publishers.

Grunden, K. (2009) "A Social Perspective on Implementation of e-Government: A Longitudinal Study at the County Administration of Sweden." *The Electronic Journal of E-Government*, Vol. 7, Issue 1, January 2009, pp. 49-60. Accessible at: http://www.ejeg.com/issue/download.html?idArticle=180

Landsbergen, D. (2010) "Government as Part of the Revolution: Using Social Media to Achieve Public Goals." *The Electronic Journal of E-Government*, Vol. 8, Issue 2, December 2010, pp. 134-146. Accessible at: http://www.ejeg.com/issue/download.html?idArticle=204

McNeal, R., Hale, K. and Dotterweich, L. (2008) "Citizen–Government Interaction and the Internet: Expectations and Accomplishments in Contact, Quality, and Trust." *Journal of Information Technology & Politics*, Vol. 5, No. 2, pp. 213-229. Accessible (with purchase) at: http://www.tandfonline.com/doi/abs/10.1080/19331680802298298

Miori, V. and Russo, D. (2011) "Integrating Online and Traditional Involvement in Participatory Budgeting." *The Electronic Journal of E-Government*, Vol. 9, Issue 1, January 2011, pp. 41-57. Accessible at: http://www.ejeg.com/issue/download.html?idArticle=222

Nygren, K. G. (2009) "e-Governmentality: On Electronic Administration in Local Government." *The Electronic Journal of E-Government*, Vol. 7, Issue 1, January 2009, pp. 39-48. Accessible at: http://www.ejeg.com/issue/download.html?idArticle=179

Ochara-Muganda, N. and Van Belle, J.-P. (2010) "The Link between the Conceptualization of eGovernment and its Perceived Impacts: An Exploratory Empirical Study in Kenya." *The Electronic Journal of E-Government*, Vol. 8, Issue 2, December 2010, pp. 161-174. Accessible at: http://www.ejeg.com/issue/download.html?idArticle=206

Pina, Vicente; Torres, Lourdes; Acerete, Basilio. (2007). "Are ICTs Promoting Government Accountability? A Comparative Analysis of E-governance Developments in 19 OECD Countries." *Critical Perspectives on Accounting.* Volume 18, Issue 5, July 2007, pp. 583-602. Accessible (with purchase) at: http://www.sciencedirect.com/science/article/pii/S1045235406000220

Schwester, R. W. (2009). "Examining the Barriers to e‐Government Adoption." *The Electronic Journal of E-Government*, Vol. 7, Issue 1, January 2009, pp. 113-122. Accessible at: http://www.ejeg.com/issue/download.html?idArticle=184

Welch, E. W., Hinnant, C. C., and Moon, M. J. (2005). "Linking Citizen Satisfaction with E-Government and Trust in Government." *Journal of Public Administration Research and Theory*, Vol. 15, Issue 3, July 2005, pp. 371-391. Accessible (with purchase) at: http://jpart.oxfordjournals.org/content/15/3/371.short

Public Safety and Disaster Communications:

Hallahan R. and Peha, J. M. (2008). "Quantifying the Costs of a Nationwide Broadband Public Safety Wireless Network." Paper presented at the 36th Telecommunications Policy Research Conference (TPRC), Arlington, VA, September 26th – 28th, 2008. Accessible at: http://users.ece.cmu.edu/~peha/costs_of_public_safety_network.pdf

Hallahan R. and Peha, J. M. (2010). "Policies for Public Safety Use of Commercial Wireless Networks." Presented at the 38th Telecommunications Policy Research Conference, Oct. 2010. Accessible at: http://papers.ssrn.com/sol3/papers.cfm?abstract_id=1989600&

Jaeger, P. T., Shneiderman, B., Fleischmann, K. R., Preece, J. Qua, Y., and Wua, P. F. (2007). "Community Response Grids: E-Government, Social Networks, and Effective Emergency Management." *Telecommunications Policy*, Vol. 31, Issue 10, pp. 592–604. Accessible (with purchase) at: http://www.sciencedirect.com/science/article/pii/S0308596107000699

Kirby, P. (2007). "Public Safety, Industry Differ on Broadband Network Plan." *Telecommunications Reports*, Vol. 73, Issue 6, Mar 2007, pp. 37-40. Accessible (with purchase) through: http://www.tr.com/newsletters/tr/

Ochoa, S.F., Neyem, A., Pino, J. A. and Borges, M.R.S. (2007). "Supporting Group Decision Making and Coordination in Urban Disasters Relief Efforts." *Journal of Decision Systems*, Vol. 16, Issue 2, pp. 143-172. Accessible (with purchase) at: http://www.tandfonline.com/doi/abs/10.3166/jds.16.143-172#preview

Peha, J. M. (2006). "From TV to Public Safety: The Need for Fundamental Reform in Public Safety Spectrum and Communications Policy." *New America Foundation*, Working Paper #15. Accessible at: http://www.newamerica.net/files/WorkingPaper15_TVtoPublicSafety_Peha_FINAL.pdf

Tanner, A., Friedman, D.B., Koskan, A., and Barr, D. (2009). "Disaster Communication on the Internet: A Focus on Mobilizing Information." *Journal of Health Communication: International Perspectives*, Vol. 14, Issue 8, pp. 741-755. Accessible (with purchase) at: http://www.tandfonline.com/doi/abs/10.1080/10810730903295542#preview

Underwood, S. (2010). "Improving Disaster Management." *Communications of the ACM*, Vol. 53 Issue 2, February 2010, pp. 18-20. Accessible at: http://cacm.acm.org/magazines/2010/2/69366-improving-disaster-management/fulltext

REFERENCES

[1] 2010 census data for Alaska at http://live.laborstats.alaska.gov/cen/. An additional 51,875 identified themselves as racially composed of two or more races; a significant percentage of these are likely to be partly Alaska Native.

[2] See www.terra.gci.com.

[3] See http://www2.ntia.doc.gov/grantee/connected-nation-alaska.

[4] Horrigan, John. "Broadband Adoption and Use in America." *The FCC Omnibus Broadband Initiative (OBI) Working Paper Series.* Washington, DC: Federal Communications Commission, 2009.

[5] National Telecommunications and Information Administration. *Digital Nation: 21st Century America's Progress Toward Universal Broadband Internet Access*. Washington, DC, February 2010.

[6] Economics and Statistics Administration and the National Telecommunications and Information Administration, *Exploring the Digital Nation: Home Broadband Internet Adoption in the United States.* Washington, DC:, November 2010.

[7] National Telecommunications and Information Administration. *Digital Nation: 21st Century America's Progress Toward Universal Broadband Internet Access*. Washington, DC, February 2010.

[8] "For Asian-Americans, American Indians, and Alaskan natives, the sample yielded fewer than 100 respondents in each group. The first two groups in particular have a sizable population that may not speak English or that have low telephone penetration rates. Because of that and the small sample of respondents, it is inadvisable to report results." Quoted in Horrigan, John. "Broadband Adoption and Use in America." *The FCC Omnibus Broadband Initiative (OBI) Working Paper Series.* Washington, DC: Federal Communications Commission, 2009, p. 14.

[9] Economics and Statistics Administration and the National Telecommunications and Information Administration, *Exploring the Digital Nation: Home Broadband Internet Adoption in the United States.* Washington, DC:, November 2010.

[10] Federal Communications Commission. *Eighth Broadband Progress Report.* Released August 21, 2012

[11] See http://www.connectak.org/research/residential-survey-methodology.

[12] OECD. "European Union survey on ICT usage in households and by individuals 2012." Eurostat Model Questionnaire (version 3.2).

[13] Source: U.S. Census Bureau, American Community Survey, 2006-2010, reported in *Alaska Economic Trends*, vol. 32, no. 8, August 2012.

[14] *Alaska Economic Trends*, vol. 32, no. 8, August 2012.

[15] *Alaska Economic Trends*, vol. 32, no. 8, August 2012.

[16] Horrigan, John. "Broadband Adoption and Use in America." *The FCC Omnibus Broadband Initiative (OBI) Working Paper Series.* Washington, DC: Federal Communications Commission, 2009.

[17] Economics and Statistics Administration and the National Telecommunications and Information Administration, *Exploring the Digital Nation: Home Broadband Internet Adoption in the United States.* Washington, DC:, November 2010.

[18] Smith, Aaron. *Home Broadband 2010*. Washington, DC: Pew Internet and American Life Project, Pew Research Center, August 2010.

[19] Horrigan, John. "Broadband Adoption and Use in America." *The FCC Omnibus Broadband Initiative (OBI) Working Paper Series.* Washington, DC: Federal Communications Commission, 2009.